Electrical Review

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLIII. No. 3. NEW YORK, SATURDAY, JULY 18, 1903. ISSUED WEEKLY

ELECTRICAL REVIEW

13 to 21 Park Row *NEW YORK*

BY THE

ELECTRICAL REVIEW PUBLISHING COMPANY

CHARLES W. PRICE . . . . PRESIDENT and EDITOR
STEPHEN H. GODDARD . SECRETARY and MANAGER
RUSSELL HOWLAND . GENERAL REPRESENTATIVE
WM. HAND BROWNE, JR. . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . ASSISTANT EDITOR

WESTERN OFFICE — 40 Dearborn Street, Chicago, Ill. CHARLES FFRENCH, Manager.

EUROPEAN OFFICE — 42 Old Broad Street, London, E. C. HENRY W. HALL, Manager.

TELEPHONE CALL (private branch exchange connecting all departments) — "21 Cortlandt."

REGISTERED CABLE ADDRESS — "Electview," New York.

SUBSCRIPTIONS

One Year, United States and Canada	$3.00
One Year, Foreign Countries	5.00
Single Copies, each	10
Copies supplied for only one year back, each	25

FAN MOTORS.

These are the days when the fan motor declares dividends of many hundred per cent in fresh air and cooling breezes. Many offices and salesrooms are rendered fairly comfortable, which, without their use, would be unbearable. We may safely say that no one who has a fan motor would be willing to part with it during the hot spell, if he could not easily replace it.

It may not be out of place to say a word about the proper location of the fan. It should be placed near a window or other opening, so that it may draw in fresh air from the outside, or, in some cases, drive out heated or vitiated air, allowing fresh, cool air to flow in from another opening. Far better results will be obtained if attention is paid to this matter than if the fan motor is put in some corner where it merely stirs up the air. One is apt to think that he is obtaining the best results if the current of air is directed toward him, but more real comfort is derived when, in addition to keeping up the circulation, the motor supplies fresh air.

STREET-CAR OPERATION.

Some time ago attention was called to the opportunity for improving street-car service by making fewer stops, emphasis being laid upon the saving in time. In a recent article by Mr. W. Park, in the *Tramway and Railway World*, London, another phase of this same question is touched upon.

Service Improved by Fewer Stops.

Mr. Park shows that the greatest part of the energy required to drive the cars is used in acceleration, and that by far the greater part of this is later dissipated in the form of heat when the car is stopped by means of the brakes. This loss, of course, increases directly with the number of stops, so that by appointing fixed stopping-places and adhering to them, not only could the schedule be improved, but the car could be operated more efficiently.

The Motorman's Responsibility.

It is a rather singular thing in street-car operation that the best skill is employed in designing the generating station and the distributing circuits, and that great additional expense is incurred over what would be necessary to do the work in order that the cost of producing the power may be reduced. It is also true that much money and labor have been spent in developing the railway motor, so that it stands to-day as one of the triumphs of the electrical designer. We may have, then, a traction system which delivers the power to the car at the lowest cost for generation and distribution, and we have on the car apparatus designed to use this effectively and efficiently. But the method in which this power is used is not determined so much by the generating station and the car equipment as by the motorman, so that it may be true that this one link in the long chain from the coal pile to the car wheel is responsible for a good part of the wasted energy. The engineer's responsibility ends when he has furnished the operating department with a suitably equipped car and power for running this; but the way in which energy is applied to run the car is under the control of another department. The motorman is instructed, in the first case, in the proper way of starting and stopping, but after that he is left largely to his own pleasure. If he is lazy, he not only makes riding exceedingly disagreeable to the passengers, but causes excessive wear of the equipment and unnecessary waste of energy. The violent starting and the almost as sudden stopping of some of our street cars is undesirable and, in many cases, unnecessary. Reliable service requires close adherence to the running schedule, and this point is urged upon the car crews as of the first importance. It seems rather surprising, to say the least, for a company to lay out so much capital in order to generate power efficiently, and yet pay so little attention to its effective use. The comfort of the passengers certainly counts for something, and energy generated through expensive machinery is worth saving. It would seem as though attention to these points would pay better than a stricter adherence to the running time.

Drifting the Car.

Mr. Park also calls attention to the great saving which can be effected by allowing the cars to drift for a longer time. In the case considered the efficiency was raised from forty-nine per cent to sixty-two per cent, but with a resulting lower average speed. However, the lower speed decreases the earning capacity of the car by reducing the possible car-miles per day. The whole question is an interesting one, which seems well worthy the attention of operating engineers. Street cars are intended to carry passengers, and it should be the object of the roads to get them to their destinations; but there are many ways of doing this, and every road should endeavor to determine the best way.

A WIRELESS TELEGRAPH INCIDENT.

A short time ago, while Dr. J. A. Fleming was delivering a lecture at the British Institution, a practical demonstration of the Marconi system of wireless telegraphy was made during the meeting. Messages from Poldhu were received successfully until near the close of the hour, when it became evident that some one was interfering with the working of the system. Dr. Fleming naturally was much provoked, and in a letter to the London *Times* expressed freely his opinion of the perpetrators of this—as he called it—"scientific hooliganism."

This letter brought a reply from Mr. Nevil Maskelyne, in which he acknowledged the soft impeachment, explaining that the attempt at interference was carried out for the benefit of the public, and that he had allowed the transmission of messages to go on for almost the entire hour without breaking in. Mr. Maskelyne says that in the announcement of the lecture it was stated that experimental illustrations of syntonic electric wave telegraphy would be given, and the interfering transmission system which he had set up had not been tuned in any way. He holds that his tests show either that Marconi's syntonic system is not proof against interference from an untuned transmitter, as in that case he could not have interferred, or that the experiments were not carried out according to the syllabus of the lecture.

Since then a number of letters have appeared in the *Times,* from Dr. Fleming and Mr. Maskelyne, each writer insisting upon the justness of his side of the squabble. At this distance it is imposible to see who is in the right. One can sympathize with Dr. Fleming when, instead of an expected message from Poldhu, he received the word "rats." One can also appreciate the temptation to Mr. Maskelyne to show that he too knows something about wireless telegraphy. He has been diligently catching and studying the messages sent out from Poldhu for some time past. It is not clear what will be the outcome of the discussion, nor how it will affect wireless telegraphy in England. Dr. Fleming said he would receive messages from Poldhu, and he made good his word. Mr. Maskelyne undertook to interfere, and he was successful. There seems to be no denial of these two facts, but when one tries to resolve the discordant note of the quarrel into its rights and wrongs he finds the fundamental entirely masked by the harmonics of accusation and denial.

THE STORAGE BATTERY IN SUBSTATIONS.

The paper on "The Storage Battery in Substations," read at the recent convention of the American Institute of Electrical Engineers by Professor Goldsborough and Mr. Fansler, is a timely addition to the discussion that has been carried on for several years as to the economic value of storage batteries as equalizers in power plants supplying current to loads which fluctuate rapidly.

Complete Test Not Possible.

While it has been the general impression that equalizing batteries lead to more economical generation and distribution of electrical energy, it is by no means universally admitted. Professor Goldsborough, however, in the discussion that followed the reading of his paper, stated that the attempt to test the plants discussed with the batteries out of commission was stopped by the officers of the railway, because of the undue and excessive strains on the machinery and the unsatisfactory character of the service as supplied by the generating and substation machinery alone. This, in view of the low *efficiency of equalization* and the fact that the railway and plant are both large, is important.

Efficiency of Equalization.

The term *efficiency of equalization* is a good one and fills the requirement for some short term or phrase to represent the percentage of change in the normal generator current under an external fluctuating load. An unchanging generator current with a load fluctuating between zero and a maximum represents 100 per cent "efficiency of equalization"—all the excess above normal current being supplied by, and the deficiency being absorbed by, the battery.

Factors Affecting the Efficiency of Equalization.

This efficiency of equalization is not, however, a function of the size or character of the battery, provided there are approximately enough cells in series. The size of the booster and the character of its windings are really the determining factors. In the stations tested by the writers of the paper the efficiency of equalization was less than twelve per cent, which is remarkably low. In present practice eighty-five per cent is easily attained and is not uncommon. The use of a flywheel on a booster, as suggested in the paper, while unnecessary when proper size of driving motor is used, would no doubt allow the capacity of the driving motor to be reduced, but a good shunt motor with an armature of low resistance gives a sufficiently constant speed to take care of any possible load fluctuation.

Driving Motors Too Small.

It is stated in the paper that the driving motors were not large enough to hold up to the average speed with the heaviest loads on the line. This appears to be an unusual condition and one not generally encountered, as the tendency is to make the motors too large rather than too small. The proper motor capacity is subject to very close calculation and there seems to be no reason why undersized motors should ever be employed.

Fuel Saving Due to Battery Not Determined.

It is unfortunate that the test could not be made on the system with the batteries out of service, as the most vital of all questions involved—the decrease in coal consumption effected by equalizing and maintaining a constant load on the generator—could have also been settled for this particular case, at least, and the results would have had a practical bearing on nearly all cases where regulating batteries are employed.

Value of Battery Installations.

Altogether the inability to operate successfully the railway without the batteries seems to indicate their desirability, even if the coal consumption were not reduced, and in view of the knowledge concerning the relative economy of steam engines on constant and on fluctuating loads, it is not conceivable that the load equalization is without beneficial effects on the coal pile.

METHODS OF COMBINING RESISTANCES—IV.

BY EDWIN F. NORTHRUP.

(Concluded.)

OTHER COMBINATIONS OF COILS.

The only combinations of *four* coils which will give the decade in the above manner are the coils *n* (1 — 1 — 4 — 3) and the coils *n* (1 — 3 — 3 — 2) as given. Here *n* may have any value. The decade may also be obtained in a manner similar to the above by using the following arrangements of *five* coils, *n* (1 — 1 — 2 — 2 — 3) and *n* (1 — 2 — 2 — 2 — 2) and *n* (1 — 1 — 1 — 1 — 5). Eleven values, namely, 0 to 10, inclusive, may be obtained from the following arrangements of *five* coils.

n (1 — 2 — 3 — 2 — 2)
n (1 — 5 — 1 — 1 — 2)
n (1 — 3 — 1 — 3 — 2)
n (1 — 1 — 1 — 3 — 4)
n (1 — 1 — 1 — 4 — 3)
n (1 — 1 — 4 — 1 — 3)
n (1 — 3 — 1 — 3 — 2)
n (1 — 2 — 1 — 4 — 2)

The method may be indefinitely extended so as to obtain any number of successive values with the use of very much fewer coils than the values obtainable. Thus from the seven coils *n* (1 — 1 — 3 — 1 — 3 — 3 — 2), we can get fifteen consecutive values inclusive of 0.

With the above methods sliding contacts or dial switches can be used in place of a plug for making the connections. The switch or dial construction has the very great advantage of it not being necessary to use any sliding contacts or flexible cords for carrying the current into the switch at its centre, as the brush which travels over the blocks will consist merely of a short-circuiting piece.

MULTIPLE ARRANGEMENTS.

Resistance coils may be connected in parallel either for obtaining regularly increasing values of current, the applied electromotive force remaining constant, or for obtaining regularly increasing values of resistance.

The principle of the first case is more generally employed for current regulating purposes than for precision work. The connections are usually made when plugs are used as shown in Fig. 24.

The resistances (lamps are often used) are all of the same value, and as plugs are inserted from right to left, the current increases by regular increments. The resistance, however, assuming there are ten coils, decreases according to the series 1, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{6}$, $\frac{1}{7}$, $\frac{1}{8}$, $\frac{1}{9}$, $\frac{1}{10}$.

The principle of the second case in which regularly increasing values of resistance are obtained may be applied in the matter indicated by Fig. 25.

It may be shown that when ten coils have the values *n* (2, 6, 12, 20, 30, 42, 56, 72, 90, 10) ohms, where *n* has any value their resistance, when all are connected in multiple, is *n* ohms. Also the nine coils *n* (6, 12, 20, 30, 42, 56, 72, 90, 10) have the resistance 2 *n* ohms when connected in multiple, the eight coils *n* (12, 20, 30, 42, 56, 72, 90, 10) the resistance 3 *n* ohms, the seven coils *n* (20, 30, 42, 56, 72, 90, 10) the resistance 4 *n* ohms, etc., to *n* (10) which has the resistance 10 *n* ohms. Thus with the ten coils having the values indicated in Fig. 25, if the plugs 1, 2, 3 to 10 are all in, the resistance from *a* to *b* is one ohm. If

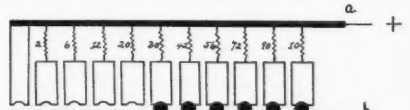


FIG. 24.

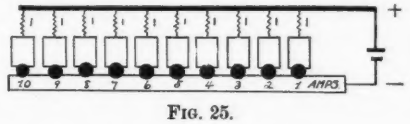


FIG. 25.

the plug 1 is removed the resistance is two ohms, if the plugs 1 and 2 are removed the resistance is three ohms, etc., that is, the resistance obtained between *a* and *b* will always be that which is stamped opposite the last plug toward the left, which is not removed.

Since the current passes through all the plugs in parallel which are not removed, their contact resistances have little influence. Also each of the coils has current-carrying capacity of the combinations of coils.

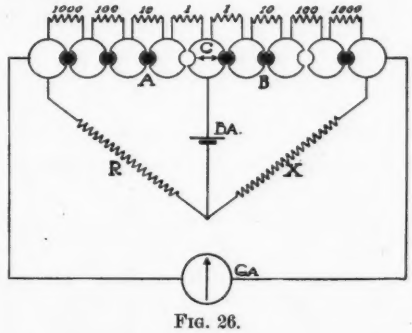


FIG. 26.

In consequence of the above considerations, this method is an excellent one to a considerably higher resistance than that obtained between *a* and *b*, and further, the lower this resistance the greater is the employ when it is required to obtain ten regularly increasing values of very low resistance, as for example, 0.001, 0.002, 0.003 to 0.01 ohm. Much greater precision of adjustment can be got and maintained by this parallel arrangement of coils of relatively high resistance than can be obtained from any arrangement of low-resistance coils in series.

In constructing a rheostat based upon this principle and having several decades, it would only be required to have the values run from 0 to 9 *n* in all decades except the one of lowest denomination. In this case the proper values for the coils to be joined in parallel are *n* (2, 6, 12, 20, 30, 42, 56, 72, 9).

Rheostats constructed on the above plan may, of course, make use of dial switches instead of plugs, each switch consisting of a semi-circular wing which makes contact with a semi-circular row of studs.

RATIO COILS.

Most boxes intended to serve as a Wheatstone bridge are furnished with a set of coils which form the arms of proportion or ratio coils of the bridge.

There is a choice of several different ways of arranging these coils.

The simplest arrangement, which is used in boxes not intended for high accuracy, is shown in Fig. 26.

The required ratio as 1 to 100 is obtained in this case by withdrawing a plug from each of the arms A and B. This simple arrangement is open to the objection that the contact resistance of the plugs which remain in is always included with the resistance unplugged.

All the other objections also to be urged against the use of many plugs, where a few will do, apply here. The method has the limitation that it is not possible to reverse the arms of the bridge; that is, to transpose the arms A and B. This limitation may be overcome by using a set of reversing blocks.

Fig. 27 shows the connections that would be employed in a Wheatstone bridge in which the ratio arms may be reversed.

The arrangement shown in the figure is classical, being that used in the English Post Office type of Wheatstone bridge. It is open to the objections which apply to the use of several plugs and of having to withdraw a plug to obtain the required resistance. A superior arrangement is the following.

SCHÖNE'S RATIO ARMS.

The first reference that we have seen to this method is in an article by O. Schöne, in *Zeitschrift für Instrumentenkunde*, May, 1898.

According to this arrangement all the

ratio coils have one of their terminals connected to a common terminal, which corresponds to the block marked C of Fig. 26. The other terminal of each coil is joined to a separate block. The bar A, Fig. 25, on one side of these blocks, is joined to the rheostat and the bar B, on the other side, to an X post.

In the ordinary use of this set of ratio coils two plugs only are used. One plug is inserted between the bar A and one of the blocks, 1, 1^1, 10, 10^1, etc., of the central row, and the other plug is inserted between the bar B and any one of the other blocks of the central row. There are two ratio coils of each value. In high-grade sets the values indicated in Fig. 28 would be used.

To obtain an even ratio, as 1000 to 1000^1, one plug would be inserted between the block 1000 and the bar A, and the other plug between the block 1000^1 and the bar B. This disposition of the plugs connects the end of the 1000-ohm coil to the rheostat, and the end of the

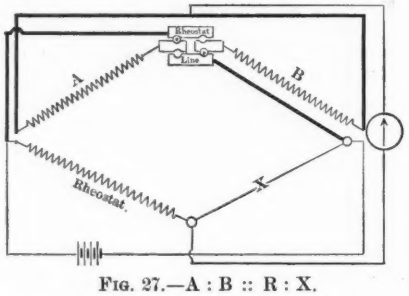


FIG. 27.—A : B :: R : X.

1000^1-ohm coil to the X post. If now one plug is inserted between 1000^1 block and the bar A, and the other plug between the 1000 block and the bar B, the ratio arms are reversed; that is, the 1000^1-ohm coil is joined to the rheostat, and the 1000-ohm coil to the X post.

When uneven ratios are used the same ratio can be obtained by four different combinations. If we wish to obtain the ratio one to ten, we can plug between A and 1 and B and 10 and get 1 to 10. Or between A and 1^1 and B and 10 and get 1^1 to 10. Or between A and 1 and B and 10^1 and get 1 to 10^1. Or between A and 1^1 and B and 10^1 and get 1^1 to 10^1.

To obtain the reciprocal set of ratios, like the above, we would plug A and 10, B and 1, and get 10 to 1; A and 10^1, B and 1, and get 10^1 to 1; A and 10, B and 1^1, and get 10 to 1^1; A and 10^1, B and 1^1, and get 10^1 to 1^1.

By using more than two plugs and connecting certain of the coils in parallel combinations, a large number of other ratios may be obtained. For example, we can plug between A and 100 and A and 100^1, and between B and 1000 and get the ratio 50 to 1000. Or we can plug between A and 1000 and A and 1000^1 and between B and 100 and get the ratio 500 to 100.

With this arrangement of ratio coils

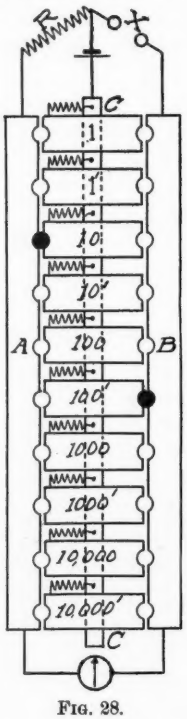


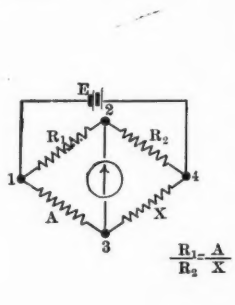
FIG. 28.

it is seen that errors due to plug contacts become practically nil, because only two plug contacts enter the circuit, while with even ratios it is only the *difference* in the resistance of the two plug contacts, which effects the result.

Schöne's arrangement of ratio coils is by far the best that has been devised and should ultimately displace all others on high-grade resistance sets.

COMMUTATOR METHOD.

The following method was devised by the writer to be used in connection with the commutator rheostat described in the first section of this article, Figs. 14 and 15.



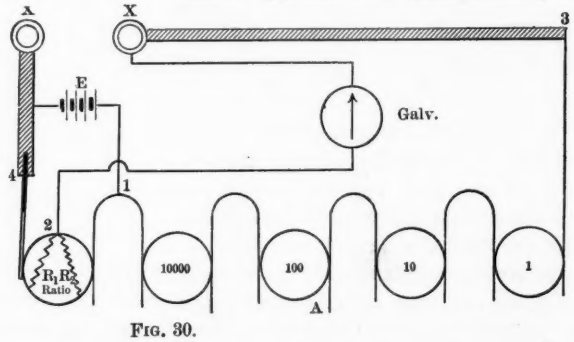


FIG. 30.

The method of obtaining the ratios is evident from Fig. 29 without further explanation. Either the brushes may move or the brushes may remain stationary, and the commutator with the coils attached may move. This method has been employed by the writer in practice in connection with portable testing sets with excellent results. Fig. 30 shows how the connections would be made. The method may be varied by using in place of the brushes two plugs that travel between a central bar to which the point (2), Fig. 29, is attached and the blocks corresponding to the segments on the commutator. It should be stated in general, that almost all methods for operating either ratio coils or rheostats, in which the desired values are obtained by putting plugs in are to be preferred to methods in which the values are obtained by taking plugs out.

It may be stated, in conclusion, that most of the general methods described above for combining resistances apply also to the combining of other elements of an electric circuit, such as condensers or standard coils of self-induction.

Many of the commutator methods for combining circuits might find useful application in decorative electric lighting, where many lamps are to be thrown in

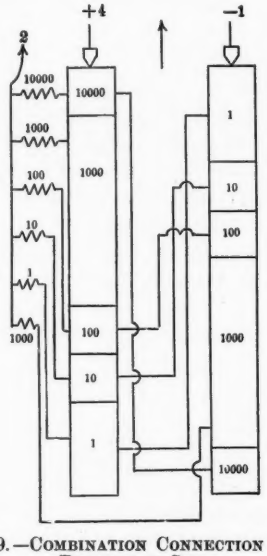


FIG. 29.—COMBINATION CONNECTION FOR A RESISTANCE SET.

circuit in various combinations. Combining commutators have also found extensive application in synchronous printing telegraphy. In this latter case relays would take the place of resistances, and impulses would be sent through the printing magnet at given intervals, according to the combinations of closed relays which the combination commutator throws in circuit.

Some Typical California Installations.

The Municipal Plant of the City of Riverside; the Power Development Company, of San Francisco; the San Bernardino Gas and Electric Company; the Merced Gas and Electric Company; and the Standard Consolidated Mining Company, of Bodie.

By J. H. Rusby.

MUNICIPAL ownership of lighting plants has been much discussed of late, as regards the economic advantages. A plant which has given much satisfaction under municipal control and operation is that of the city of Riverside, Cal.

The plant was originally constructed by the city in 1896. The station was then twenty-six by twenty-six feet. Since then the plant has been enlarged several times as the city grew, and to-day, after another recent addition which leaves the station considerably larger than the exterior view shows, the dimensions and outfit are as follows:

The station is built of red brick, 75 by 150 feet, including the pump rooms. Outside, some distance from the station, are two oil tanks of 35,000 gallons capacity each, which feed the boilers and supply also the city and county with oil for oiling the roads, a treatment which is given the roads of California pretty generally.

The boiler outfit consists of four Stirling boilers of 100 horse-power each. These supply steam for two Woodberg simple Corliss 350-horse-power engines, 20 inches by 42 inches, eighty revolutions per minute with fourteen-foot flywheel, weighing 16,500 pounds. These are belted to two General Electric 175-kilowatt, triphase, 7,200 alternations, sixty-cycle, 2,300-volt, revolving-field compensating generators.

Current is taken through three and six-kilowatt General Electric series equalizers to two primary gray marble panels, fitted with main oil-break switches and General Electric fittings and instruments, to the main switchboard of two gray marble panels fitted with all accompanying fittings, including double-throw, oil-break switches, by means of which the bus-bars may be loaded from either this station or the Redlands plant of the Edison Electric Company, of Los Angeles.

In addition to power generated here, at Riverside the station receives some 600 horse-power from the Redlands station. This power is received over a three-phase line at 10,000 volts, and part is taken through eighty-five-kilowatt, Wagner, water-cooled transformers, stepping it down to 2,300 volts for street circuits along with the power generated at the Riverside station, which is distributed at 2,300 volts to General Electric pole transformers and at 200 volts to local power consumers, and 100 volts for local incandescent lighting. The regulating and recording instruments for Redlands power are Bristol's, including potential regulator, ammeters and voltmeter.

The city also supplies power to the Riverside and Arlington Railway Company, operating about ten cars.

The 10,000 volt current enters three forty-kilowatt General Electric intermediate step-down transformers, bringing it down to 360 volts, whence it enters a 100-kilowatt rotary converter, which trans-

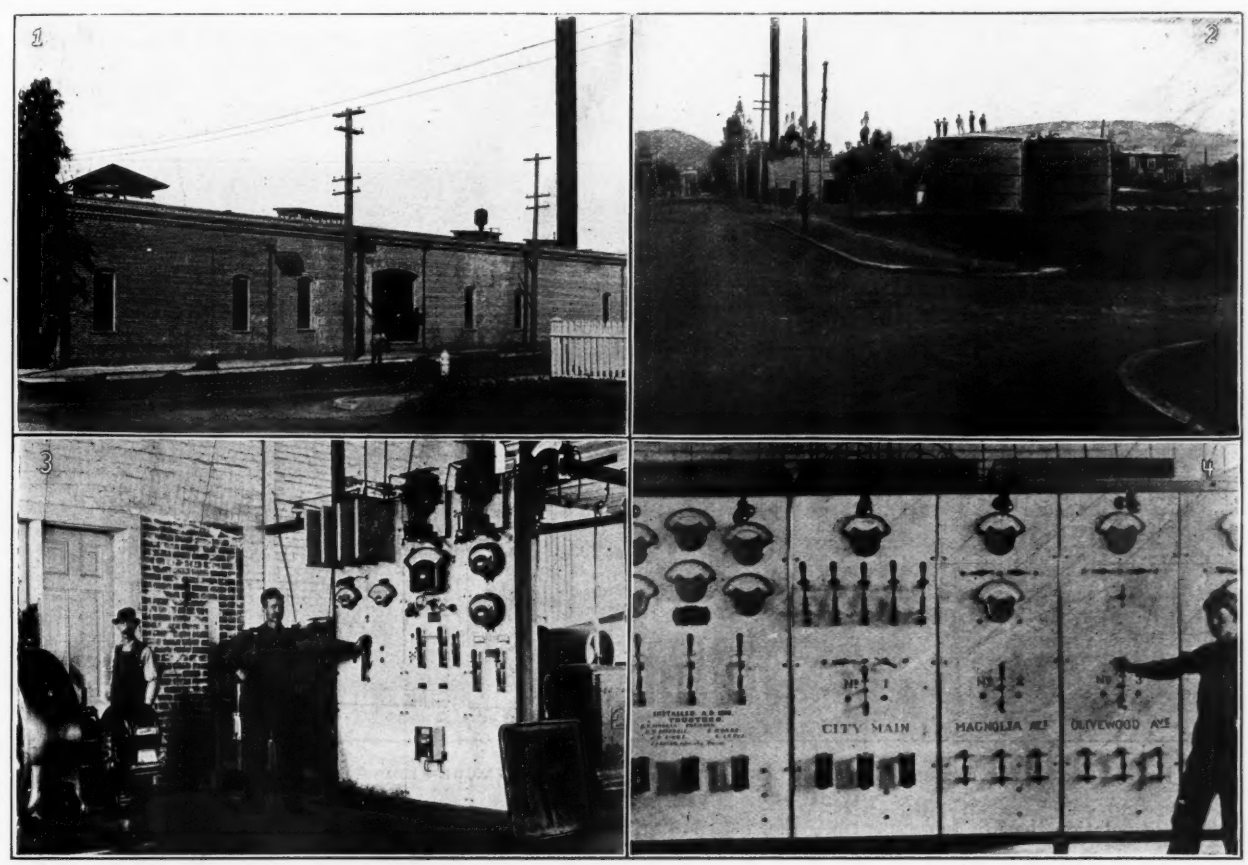


FIG. 1.—THE RIVERSIDE, CAL., MUNICIPAL LIGHT AND POWER PLANT BUILDING. FIG. 2.—THE 35,000-GALLON STORAGE TANKS FOR THE FUEL OIL. FIG. 3.—THE HIGH-TENSION SWITCHBOARD. FIG. 4.—THE DISTRIBUTING PANELS.

forms to 560 volts direct-current for outside car line use.

In addition to the power purchased from the Redlands plant of the Edison company, the city has contracted for the total output of the East Riverside Power Company, now erecting its plant, with a capacity of 600 horse-power, which will be run into the Riverside station over a 10,000-volt, triphase line, and will be stepped down through three 200-kilowatt transformers to 2,300 volts for distribution.

The city furnishes nearly all the motive power for the various industries about town, including laundries, packing houses, lumber and planing mills, pumping stations, etc. In fact, it is quite extraordinary to see a private steam plant in town.

one of 220 horse-power, and one of 150 horse-power. These engines are belted to one end of a line shaft running through the station.

The other end of the shaft is fitted with a 150-horse-power, Stilwell-Bierce water turbine, for use when water is abundant.

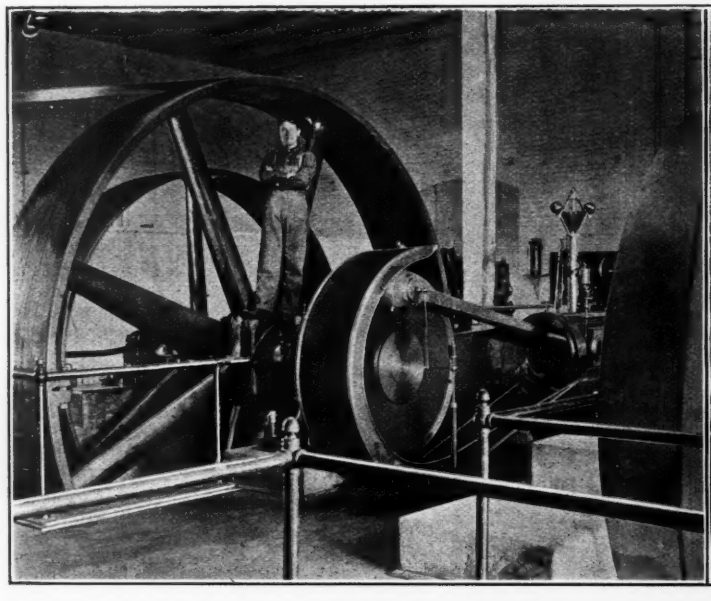
To this line shaft are belted three generating units, as follows: one 150-kilowatt, 2,400 volt, triphase, 7,200 alternating, sixty-cycle, for day and night incandescent lighting; two Wood arc machines, 4,000-volt, eighty horse-power each, for series arc lighting.

The alternator is separately excited by direct-current, 125-volt machine. Power is distributed through a two-inch gray marble board, fitted with General Electric instruments and plain quick-break knife switches, for the incandescent lighting, and Wood instruments for the arcs.

in the country is shown in the following description of the Bakersfield plant of the Power Development Company, of San Francisco, Cal.

The generating station of this plant, which was originally installed in 1897 under the charge of Dr. C. T. Hutchinson, of New York city, electrical engineer; Messrs. Cobb and Hesselmeyer, of San Francisco, mechanical and hydraulic engineers; W. R. Macmurdo, of Bakersfield, civil engineer, and Walter James, of Bakersfield, consulting engineer. The whole work being in direct charge of Mr. C. N. Beal, secretary and treasurer of the Power Development Company, has undergone some important alterations since the original installation.

The generating station is located at the mouth of the Kern River cañyon on the western slope of the Sierra Nevada mountains, sixteen miles northeast of Bakersfield, Cal.



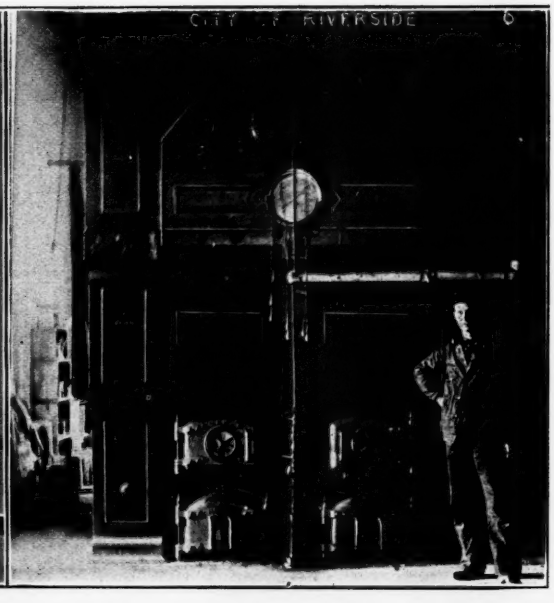


FIG. 5.—ONE OF THE ENGINES, RIVERSIDE, CAL., MUNICIPAL LIGHTING AND POWER PLANT. FIG. 6.—ONE OF THE BOILERS.

In this city station the fire department batteries are kept, consisting of about eighty-five standard sized cells. The prospect bespeaks a very bright future for the city of Riverside as regards the lighting and power department. We are indebted to Mr. F. A. Worthley, superintendent, for descriptive matter, and to Mr. Weidman, chief engineer, for views.

THE SAN BERNARDINO GAS AND ELECTRIC COMPANY, SAN BERNARDINO, CAL.

This company has two generating plants or stations, the Mill street and the Highgrove. The Mill street station includes two 16 inch by 66 inch return tubular, 145-pound Philadelphia Boiler Company's boilers, having a combined capacity of 300 horse-power, oil fuel being used; two tandem-compound Ball engines,

The alternating current at 3,400 volts supplies a load of 4,000 incandescent lights through pole transformers, and the arc circuits a load of 160 arc lamps. Edison base sockets and lamps are used throughout. These Mill street machines run in balance with the Highgrove station, which includes the following apparatus: One Stilwell-Bierce double water turbine of 280 horse-power capacity, driving a line shaft to which is belted a 150-kilowatt General Electric, 2,400-volt, triphase, 7,200-alternating, sixty-cycle alternator, separately excited. From this alternator current is taken through a brown slate board fitted with necessary instruments to reinforce the Mill street circuits.

THE POWER DEVELOPMENT COMPANY, SAN FRANCISCO, CAL.

One of the highest grade and most interesting engineering efforts for its size

The river which is third in size in California here furnishes ample power for generating purposes, 7,000 horse-power being secured at this point the year round by tapping the stream some two miles above the station site.

Originally the water was carried down a redwood flume eight feet wide and six feet deep, with a fall of 5.28 feet per mile, giving 14,400 cubic feet of water per minute.

As this flume possessed certain disadvantages in operation, however, principally due to rock and timber falling into it, in spite of a cover, a tunnel six feet by seven feet was bored one and three-quarter miles through solid granite, in 1901, which settled for all time all trouble in that direction.

The generator driving power was originally provided by four Girard water wheels. These have been taken out and replaced by three Knight 750-horse-power

undershot wheels, which are direct-connected to three 450-kilowatt, triphase, twenty-eight-volt, 7,200 alternations per minute, 550-volt, General Electric generators. These generators are excited by two seventeen and one-half kilowatt, General Electric, multipolar, direct-current units, separately direct-connected to Knight wheels.

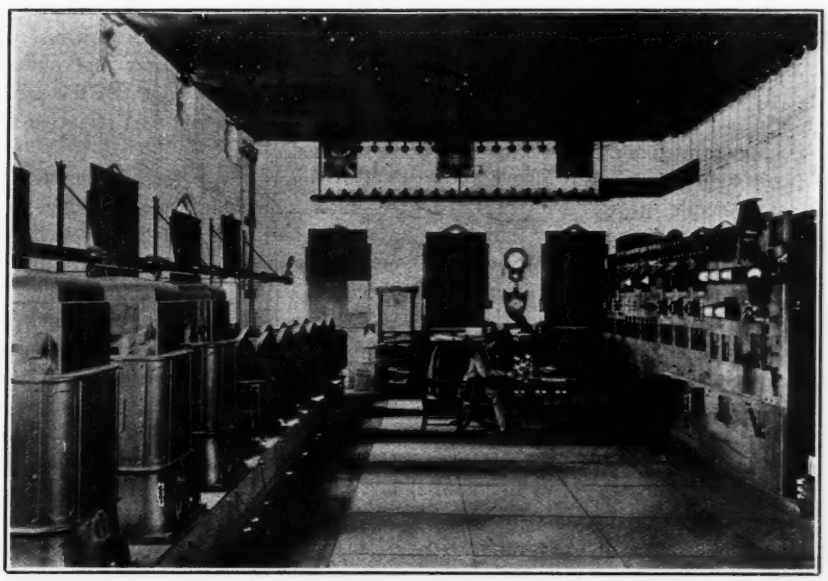
Current is then taken at 550 volts through nine 100-kilowatt, air-blast transformers, stepping up to 10,000 volts, and thence through a switchboard of two-inch gray marble, fitted with complete outfit of General Electric instruments, including knife switches, whence it is led out through lightning arresters and kick coils to the line, which consists of two three-wire circuits of No. 4 soft-drawn bare copper wire, run on redwood poles twenty-four feet above ground, six by six inch top and nine by nine inch butt. Current enters the substation at Bakersfield, fourteen miles distant, through the customary devices, including high-potential, triple-pole, multiple-break fused switches, especially designed by Mr. Whoof, superintendent, to three banks of three each seventy-five-kilowatt air-blast transformers, stepping down to 2,080 volts, for local distribution by a secondary board, fitted out with all instruments and appliances, to street lines and street transformers which deliver the power to consumers at 115 volts.

Edison base sockets and lamps are used. Bakersfield and Kern territory is supplied, together with certain outlying consumers along the line from the generating station. The present load is about seventy-five series enclosed arcs and 25,000 incandescent lamps; also the Bakersfield & Kern Electric Railway Company is supplied by means of a 100-kilowatt rotary converter, started by means of a 4.2-kilowatt induction motor. This railway equipment consists of four single-truck, twenty-five-horse-power Holman closed cars and three duplex-truck, twenty-five-horse-power Holman combination cars.

POWER DEVELOPMENT COMPANY, SAN FRANCISCO, CAL.—INTERIOR OF BAKERSFIELD SUBSTATION, SHOWING ROTARY CONVERTERS, ETC.

THE MERCED GAS AND ELECTRIC COMPANY, MERCED, CAL.

The main generating station is situated at Merced Falls, Cal. Four Leffel water-wheels, aggregating 600 horse-power, under a seventeen-foot head, transmit running power to one 240-kilowatt and one 135-kilowatt Stanley, three-phase, 7,200-alternation-per-minute, sixty-cycle, 2,400-volt generators, from which the current is transmitted through air-blast transformers, stepping up to 10,000 volts, to a white marble board, fitted with the regulation instruments and plain knife switches, to the line. This is composed of three No. 6 bare copper wires, and stretches to the Merced substation, twenty-four miles distant, where it enters through lightning arresters and kick coils to air-blast transformers and is stepped down to 2,400 volts, whence it is transmitted through a secondary switchboard of white marble, fitted with Whitney and Thompson instruments and knife switches



POWER DEVELOPMENT COMPANY, SAN FRANCISCO, CAL.—INTERIOR OF BAKERSFIELD SUBSTATION, SHOWING TRANSFORMERS AND SWITCHBOARD.

to outside street lines at two-phase current and through street transformers to various consumers at 100 volts.

The present load is six enclosed arcs and 3,000 incandescent lamps. It is intended soon to supply the Mount Gaines gold mines along the high-tension line with power and lights.

At the Merced substation the company has a reserve plant consisting of the following: One two-phase, 7,200-alternation-per-minute, sixty-cycle, 2,400-volt, 135-kilowatt, and one two-phase, 7,200-alternation-per-minute, sixty-cycle, 2,400-volt, thirty-five-kilowatt generators, excited by two 125-volt, direct-current exciters, this whole outfit being belt-driven by one Ideal 150-horse-power and one Ball sixty-horse-power steam engine, fed by one 100-horse-power and one eighty-horse-power oil fuel boilers.

THE STANDARD CONSOLIDATED MINING COMPANY, BODIE, MONO COUNTY, CAL.

The generating plant is situated at Green Creek. Four twenty-one-inch Pelton wheels under a 350-foot head drive, one Westinghouse alternating-current, 120-kilowatt, single-phase generator.

Current is stepped up by Westinghouse transformers to 10,000 volts, and transmitted over a circuit of No. 1 bare copper wire on two and one-half mile pile line, containing sixteen and one-half tons of copper, to Bodie, where it is stepped down and drives a Westinghouse 120-kilowatt synchronous motor. This drives a twenty-stamp and ten-pan mill. The plant is supplied with Westinghouse fittings and instruments.

The Fifth International Congress for Applied Chemistry, Held in Berlin, June 2 to 8, 1903.

Report by John B. C. Kershaw, London.

[*Specially written for the* ELECTRICAL REVIEW.]

THE international congress of applied chemistry, which was held in Berlin from the second to the eighth of last month, was the fifth of the series, inaugurated at Brussels in 1894. The succeeding congresses have been held at intervals of two years in Paris, Vienna and Paris, respectively, but three years have elapsed since the last congress (held in Paris in the exhibition year 1900), and it is probable that the congress will now become a triennial fixture in the chemists' calendar. The aim of these congresses is threefold. In the first place, by bringing chemists of all nationalities together they serve to break down political and national barriers to knowledge and friendship, and assist in widening the field of human intercourse. In the second place, by the opportunities they offer for reading papers bearing on the application of chemistry in the arts and industries, they help to spread the knowledge of what is being done in those countries which are most advanced, and they thus serve to raise the level of industrial efficiency the wide world over. And, finally, by the appointment and labors of international commissions, which hold sittings and report to succeeding congresses on the questions submitted to their members, these congresses assist in the attainment of international action and regulations in matters of the highest importance to the chemical industries. By many, this last is held to be the most important and useful branch of their work, and when the members of these commissions are wisely chosen, and are thoroughly representative of the different nationalities, there is evidence that the results of their labor are appreciated and receive international sanction and adoption.

In this report of the proceedings of the fifth international congress, which was attended by over 2,000 members, and at which the enormous number of 456 papers and reports were planned for reading before the eleven sections into which the congress was divided, it will be impossible to give the titles of all the papers actually read, and detailed notice will be restricted to those papers and reports which may be supposed to have a special interest for readers of the ELECTRICAL REVIEW. Section X of the congress was devoted to electrochemistry and physical chemistry, and it is chiefly to the papers read before this section that attention will be directed.

The congress was formally opened on Wednesday morning, June 3, in the large assembly hall of the Reichstag Gebäude, one of the largest and finest buildings in Berlin.

The action of the government in placing the whole of the Imperial Parliament building in the hands of the organizing committee for the congress week is characteristic of the German official attitude toward science, and a building more admirably adapted for the general and sectional meetings of the members of the congress it would have been difficult to find.

The president of the congress, Professor Otto Witt, of Berlin, opened the proceedings on Wednesday with a few words supplementary to his speech of the previous evening, and then called on Count von Posadowsky and Dr. Studt, the representatives of the Imperial Government, to greet the congress in the name of the state authorities.

The official representatives of foreign governments and of foreign scientific societies were then formally received, and each in turn spoke a few words to the assembly. France was represented at this meeting by Professor Moissan (the popular figure at the congress); Great Britain, by Professor Tilden; Austria, by Professor Ludwig; Russia, by Professor Jackowkim; Spain, by Don Vincente de Lafitte; the United States, by Professor Clark; Italy, by Professor Paterno (another popular figure at the congress), and Switzerland, by Professor Lunge. As speeches in German, French, English, Italian and Spanish were delivered, the claim of the congress to the title of international was fully justified, and there were probably few members present of sufficient linguistic ability to understand every word that was spoken at this inaugural meeting of the congress.

The real work of the members commenced on Wednesday afternoon, with the inaugural meetings of the sections I to XI. These sectional meetings were continued daily, with morning and afternoon sessions, up to Monday, June 8, when the third and final general meeting of the congress was held. The only interruption to the daily work of the sections was on Friday, June 5. On this date the second general meeting of the congress was held, and the following addresses were delivered:

1. "The Hydrides of the Metals." Professor Moissan, Paris.

2. "Modern Views on Matter." Sir William Crookes, London.

3. "The Formation of Natural Salt Deposits." Professor Van t'Hoff, Berlin.

4. "A Survey of the Ammonic Soda Industry." M. Solvay, Brussels.

5. "Auto-Oxydation." Herr Engler, Karlsruhe.

6. "New Investigations Relating to Coal-Tar." Herr Kraemer, Berlin.

Sir William Crookes' address was considered by many the best delivered at the second general meeting of the members of the congress, and it will be reproduced in full in the ELECTRICAL REVIEW at a later date. None of the other addresses dealt with subjects of special interest to electrical engineers.

As regards the work of the sections, the papers read in sections I to VI dealt with subjects outside of the province of the readers of this journal, but the following list of sections, presidents, and total number of papers planned for reading in each of the sections will no doubt prove of interest, and will show the wide field covered by the congress, and the wealth of matter provided for the consideration of its members.

Section I. Analytical chemistry—methods, apparatus and instruments. President, Professor von Knorre, Berlin. Papers to be read, fifty-two.

Section II. Chemical industry of the inorganic products. President, Dr. A. Heinecke, Berlin. Papers to be read, thirty-nine.

Section IIIA. Mining and metallurgy. President, Professor Weeren, Berlin. Papers to be read, twenty-three.

Section IIIB. Explosives. President, Professor Witt, Berlin. Papers to be read, twelve.

Section IVA. Organic products, including tar derivatives. President, Pro-

fessor Wichelhaus, Berlin. Papers to be read, forty-four.

Section IVB. Coloring matters, and their utilization. President, Dr. A. Lehne, Berlin. Papers to be read, thirty-three.

Section V. The sugar industry. President, Professor Herzfeld, Berlin. Papers to be read, thirty-three.

Section VI. The fermentation and starch industries. President, Professor Delbruck, Berlin. Papers to be read, forty-one.

Section VII was devoted to papers on Agricultural Chemistry, and was presided over by Professor Kellner, of Leipzig. The first paper read before this section at its afternoon session of Wednesday, June 3, was by Dr. Frank, of Charlottenburg, and the subject was one of some interest to electrochemists, namely, the "Fixation of Atmospheric Nitrogen and Its Use in Agriculture." The writer has more than once referred in these columns to the experimental plant of the Atmospheric Products Company, at Niagara Falls, and to the production by this company of nitrates from the air by the aid of the high-potential electric discharge. Dr. Frank in his paper described a new electrical method of obtaining nitrogen from the air. In this case calcium carbide is utilized to fix and combine with the nitrogen, and a compound known as calcium cyanamide is obtained. This substance contains from fourteen to twenty-two per cent nitrogen, and it can be employed directly for mixing with the soil, since on treatment with water it yields compounds of the uric acid series. In answer to questions, Dr. Frank stated that with cheap water power, calcium cyanamide could be produced at a price which would admit of competition with sodium nitrate and sulphate of ammonia. None of the remaining thirty-three papers planned for reading before this section was of exceptional interest to electrical engineers.

Section VIII was divided into two subsections—VIIIA being devoted to papers on the chemistry of food stuffs; and VIIIB to papers on hygiene, medical and pharmaceutical chemistry.

Dr. Merck, of Darmstadt, presided over the joint meetings of this section, and fifty-eight papers were planned for reading before the members in section VIIIA and section VIIIB. Detailed mention can only be made of the two papers on the "Utilization of Ozone for Water Purification," read at the Friday afternoon session of section VIIIB. The first of these was by Herr Proskauer, of Berlin, and dealt with the general aspects of the question of water purification by ozone. Some details of the early experimental trials by Tyndal, Marmier and others were also given. The bacteriological examination of the water used at the Martinikenfelde ozonizing plant of Messrs. Siemens & Halske was next discussed, and reference was made to the methods used by Drs. Ohhmuller and Krall, to prove the absence of pathogenic germs in the sterilized water. Dr. Erlwein followed Herr Proskauer with a second paper on the same subject, and gave a lengthy description of the water purification plants erected by Messrs. Siemens & Halske at Schierstein, near Wiesbaden, and at Paderborn, in Westphalia. Drawings of these plants, a model of the ozonizing battery and a full-sized ozonizer of the Siemens & Halske type were exhibited and explained, and the numerous automatic safety appliances, devised for cutting off the current of electricity or of water in the case of breakdown, were described. The total cost of treatment by the Siemens & Halske system of purification was stated to be 0.85 pfennig per cubic metre. A lively discussion followed the reading of this paper.

Section IX was devoted to the chemistry of photography, and was presided over by Professor Miethe, of Berlin. Of the twenty-four papers planned for reading before this section none was of special interest to electrical engineers.

The meetings of section X, electrochemistry and physical chemistry, were organized by the Deutsche Bunsen-Gesellschaft (the German society of electrochemists), and the annual meeting of the latter society had been timed to coincide with that of the congress. As a consequence of this arrangement, the meetings of section X were very numerously attended, and were held not in the Reichstag Building, but in the lecture theatre of the Physical Institute of the Berlin University. At the inaugural meeting of the section on Wednesday afternoon, June 3, fully 250 members were present, and this number was more than once approached during the later sessions of the section. Dr. Böttinger, as president of the Deutsche Bunsen-Gesellschaft, presided over section X, and a programme of fifty-one papers and reports was arranged for the consideration of the members. The more notable of these are referred to at some length below, and the following account of the meetings of section X contains a list of all the papers read, with the names of their authors.

WEDNESDAY, JUNE 3—AFTERNOON SESSION.

Dr. Böttinger opened the proceedings with a few words of greeting, and the first paper was read by Professor Traube and Herr Teichner, of Berlin, upon "An Experiment Relating to Critical Density."

The authors by an ingenious application of very minute graduated glass floats have been able to prove that considerable differences of density exist within the gaseous mixture contained in sealed glass tubes raised above the critical temperature of the liquid contained, and that the value of (b) in Van der Waal's formula is therefore not a constant, but varies with the temperature and pressure. Using carbon tetrachloride as the liquid, a temperature of 290 degrees centigrade and a pressure of 410 atmospheres within the sealed tube, the authors gave a practical demonstration of the experiment, and showed that after the meniscus had disappeared, considerable differences of density still existed in different portions of the tube. The experiment proves that the molecular constitution of liquids and gases near their critical temperature is not fully explained by the generally accepted theories.

The second paper was by Professor Nernst, of Göttingen, and related to "Vapor Density Determinations at High Temperature." Hitherto no satisfactory method of determining vapor densities at high temperatures has been worked out, but Professor Nernst has solved the very great difficulties involved in such work, and has elaborated a method applicable to gases and liquids within a temperature range of 2,000 degrees centigrade. A special form of electric furnace was devised and employed for heating the pure iridium tube containing the gases, and a novel method of measuring the temperature was also used. A new form of balance, capable of weighing with an error of not more than one ten-thousandth part of a milligramme, was also constructed and used for this work. Professor Nernst therefore surmounted the difficulties, chiefly by the exercise of his inventive skill in devising apparatus suited for the work in hand. The results obtained at the high temperatures used show that in all cases dissociation had occurred, and that the gases were present in the atomic, and not in the molecular, state. In the case of sulphur, thirty per cent of the total weight used in the experiment was dissociated, while by an indirect method of observation it was proved that oxygen likewise underwent the dissociation at a temperature of

1,900 degrees centigrade. Professor Nernst's paper received much applause.

The third and final paper read on Wednesday afternoon, June 3, was by Dr. Frohlich and dealt with a "New Material for Electric Resistance Furnaces."

The author has discovered a mixture of earths which conducts at ordinary temperatures, and can therefore be used as heating material for resistance furnaces, without any decomposition occurring at the higher temperatures. Its exact nature and composition were not revealed by the author, but it is believed to be a mixture of the rare earths with some impurity, that renders it conducting at the normal temperature. The three remaining papers set down for reading at the first session of section X were not read, owing to the absence of their authors when called upon.

THURSDAY, JUNE 4.

At the morning session the following papers were read and discussed:

1. "Colloidal Zirconium," by Dr. Wedekind, Tübingen.

The author has prepared this product and showed specimens of it in solution and as a dry powder. The metal zirconium in the colloidal state still acts as anion, and drifts toward the negative pole under the influence of the electric current.

2. "The Electrolytic Reduction of Unsaturated Compounds," by Professor Marie, Paris.

This paper was read by the author in French, and owing to the rapidity with which it was read, the writer is unable to give any intelligent abstract of its contents.

3. "The Use of Electrolysis for the Preparation of Inorganic Products," by Professor Foerster, Dresden, and Direktor Brandeis, Aussig.

In the first of the two papers Professor Foerster dealt chiefly with the theoretical side of the subject, and gave a useful tabular summary of the present theory of the electrolytic decomposition of the alkali metal chloride solutions. Professor Foerster's own work on this subject has proved that in the electrolytic production of chlorates, bromates and iodates there is a gradual extension of the range of secondary reactions, and whereas in chlorate formation these only occur in weak acid solutions, when bromates are being produced, the secondary reactions occur in neutral and alkaline solutions also.

According to Professor Foerster, all the higher oxygen salts of the alkali and other metals are now produced industrially by electrolytic methods.

The second of the papers on this subject—that by Direktor Brandeis—dealt with the practical applications of electrolysis in the production of oxygen, bromine, iodine, hydrogen, chlorine, copper, nickel, gold, silver, aluminum, sodium, chlorate, hypochlorites, soda, permanganates and bichromates. It was chiefly a résumé of facts already published, but contained the statement that the Aussig "bell" process for alkali manufacture is working at four places, and can only be operated with very low-current intensities.

4. "Electrolysis with Alternating Currents," by Professor Le Blanc, Karlsruhe.

The author has found that when working with cyanide and other solutions of copper and cadmium, electrodes of these metals, and a current of between 1,000 and 2,000 cycles per minute, there is a discrepancy between the metal deposited and that going into solution. A similar deficiency is not found to occur in the case of hydrogen, and the author attributes the deficiency in the case of copper and cadmium to the time required to form complex compounds of the cyanide type. Professor Nernst in the discussion pointed out that one cause of the difference observed was the lower migration coefficient of complex ions.

The third session of section X, on Thursday afternoon, June 4, was occupied chiefly with French papers. Professor Moissan, Professor Lebeau and M. Gin being the authors respectively of papers on "Alkali Metal Carbides," "Metallic Silicides" and "The Manufacture of Aluminum."

Professor Lebeau was accorded first place, and read his paper showing that the following series of compounds of silicon with various metals of the iron group had been produced in the electric furnace:

Silicon and iron	$SiFe_2$	SiFe	Si_2Fe
Silicon and cobalt	$SiCo_2$	SiCo	Si_2Co
Silicon and manganese	$SiMn_2$	SiMn	Si_2Mn
Silicon and nickel	$SiNi_2$	SiNi	Si_2Ni
Silicon and chromium	$SiCr_2$	Si_2Cr_3	Si_2Cr

Professor Moissan followed with his paper on the "Alkali Metal Carbides." After referring to the early work of Berthelot and others on this subject, he described the methods by which he had prepared the carbides of sodium and potassium, and more lately the carbides of rubidium and cesium, the most active of the metals of this group. To obtain the latter carbides, he embedded a thin ribbon of the metal in pure lamp-black, and then raised the metal to a high temperature by means of an electric current. Professor Moissan regards the alkali metal carbides as of some industrial importance, since on treatment with water they produce not only acetylene gas, but a by-product of considerable value. The discovery of a practical and economical method of producing sodium carbide is therefore to be desired, and research in this direction is called for.

The paper by M. Gin upon the "Manufacture of Aluminum," dealt merely with the calculated electromotive force required to decompose Al_2O_3, Al_2F_6 and Al_2S_3 respectively, and the author pointed out that the problem of cheapened production in the aluminum industry was one which the chemist rather than the electrical engineer would be called upon to solve.

The next paper read was in German, and was upon "Evidences of Metallic Action in Oxidation and Reduction Phenomena," the author being Professor Coehn, of Göttingen. Professor Coehn brought forward numerous instances in which the nature of the cathode influenced the results obtained in electrolysis, and asserted that these proved catalytic action to have occurred at the cathode surface. A very lively discussion followed the reading of this paper, and it was urged that the phenomena observed by Professor Coehn could all be explained by the "uber-spannung" caused by the formation of a thin layer of oxides and peroxides on the surface of the cathodes.

The remaining two papers read at this session of section X dealt with industrial applications of electricity, and were as follows:

5. "The Production of Steel in the Electric Furnace," by Dr. Goldschmidt, Essen.

6. "The Manufacture of Carbon Bisulphide in the Electric Furnace," by E. R. Taylor, Penn Yan.

These subjects have been recently dealt with by the present writer and Mr. E. R. Taylor in illustrated articles in the columns of the ELECTRICAL REVIEW, and the papers contained nothing very new on either subject. It is, however, interesting to note that Dr. Goldschmidt admitted, in the discussion which followed the reading of his paper, that the electric processes of steel manufacture could not compete with the older processes for the production of iron and steel from the raw materials of the manufacture, working under the most favorable conditions as regards supplies of coke and

ore, and that it was chiefly in the production of special steel alloys from scrap iron that their competition would be felt. Very cheap water power is, however, an essential factor of their development, and practically Dr. Goldschmidt is in agreement with the writer as to the future of these processes.

FRIDAY, JUNE 5—AFTERNOON SESSION.

The following papers were read and discussed at the afternoon session of Friday, June 5:

1. "Electrochemical Units," by Professor Nernst, Göttingen.

2. "Report of the Commission Appointed by the 1900 (Paris) Congress on Physical Units," by Professor Marie, Paris.

These two papers were discussed together, and it was decided that the congress should be asked to recommend for international adoption this list of signs and formulæ.

3. "The Decomposition of Carbon Monoxide," by Dr. Schenck, Marburg.

4. "The Variations in the Electric Resistance of Soot and Other Bodies Under the Influence of Light," by M. Ancel, Paris.

5. "Theories of the Contact Process for Sulphuric Acid Manufacture," by Dr. Bodenstein, Leipzig, and Dr. Bodländer, Braunschweig.

6. "Chemical Reactions at the Highest Temperatures," by Professor Zengelis, Athens.

The author, by combustion of powdered aluminum in oxygen, has been able to exceed the temperature of the electric furnaces and has also obtained a new series of nitrogen products, by substituting nitrogen or nitrous oxide gas for oxygen. By burning aluminum in carbon monoxide, he has been able to prepare the carbide of this metal.

7. "Radioactive Bodies," by Professor Marckwald, Berlin.

A paper dealing with the electrolytic separation of an alloy of radium and tellurium from uranium residues. Deposited on copper plates, this alloy is of value for experimental demonstrations of the remarkable properties of radium.

Limit of space renders it necessary that a mere list of the remaining papers read before section X on Saturday, June 6, and on Monday, June 8, should be given.

SATURDAY, JUNE 6—MORNING SESSION.

1. "A Gravity Formula Applicable to Diffusion Phenomena," by E. Solvay, Brussels.

2. "Contribution to the Theory of Reduction Phenomena," by Professor Goldschmidt, Christiania.

3. "The Value of Electrolysis in the Preparation of Organic Compounds," by Professor Elbs, Giessen, and Dr. Büchner, Mannheim.

4. "The Technical Applications of Catalytic Action," by Professor Bodländer, Braunschweig.

5. "The Formation of Complex Compounds by the Sulpho-Cyanide Ion," by Dr. Grossmann, Münster.

AFTERNOON SESSION.

1. "The Applications of Electrical Endosmose and Its Relation to the Colloidal State," by Professor Bredig, Heidelberg, and Dr. Graf, Schwerin Hoehst.

2. Adjourned discussion upon the papers of Bodländer and Bodenstein on "The Contact Processes of Sulphuric Acid Manufacture."

3. "The Physical Chemistry of Wine," by Professor Magnanini, Modena.

4. "Hydrogenation by Catalytic Action," by Professor Sabatier, Toulouse.

MONDAY, JUNE 8—MORNING SESSION.

1. "Electroplating Apparatus and Plant for Depositing Nickel on Small Articles," by Dr. Sacker, Berlin.

2. "Quantitative Separation of Metals by Electrolytic Methods," by Dr. Danneel, Aachen.

3. "Concentration of Dilute Solutions by Freezing and the Production of Freezing Mixtures," by Dr. Monti, Turin.

4. "The Light Emission of the Ions," by Dr. Werner von Bolton, Berlin.

5. "Colloidal Substances." by O. S. Burns, Boston.

6. "Theory of Concentration Changes in Diaphragm Cells for Electrolysis of Alkali Chloride Solutions," by Professor Guye, Geneva.

Section XI of the congress was devoted to papers and reports bearing on the statistical, legal and social aspects of the chemical industries, and twelve papers were discussed by its members. None of these was of special interest to electrical engineers.

In concluding this account of the proceedings of the fifth International Congress for Applied Chemistry, the writer would draw attention to the leading part taken in the sectional proceedings by the professors of chemistry in the universities and high schools of the German Empire.

Though some disadvantages no doubt were attached to this preponderance of professors and "privat dozenten" upon the organizing committees for the various sections, and also in the discussions upon the papers read; the fact that this element was present at the congress in such large numbers shows the close connection between industry and science in Germany, and the lively interest taken by the leaders of science in practical and industrial questions. In section X one result of this over-preponderance of the academical element was the very large number of papers dealing with the theoretical phenomena of electrolysis, and the addresses relating to the practical application of electrolytic methods in the arts and industries were few in number and comparatively unimportant.

Of the fifty-one papers planned for reading before the members of section X only seventeen related (even distantly) to industrial subjects; and many of these were not read, owing to the time taken up by the papers dealing with the theory of electrolysis and by the discussions thereon.

At future meetings of section X of the international congress it may perhaps be possible to obtain a greater number of papers relating to "Applied Electrochemistry," and if the time is more fairly divided between these papers and those relating to theory, it will certainly conduce to the utility and benefit of the gathering.

Ball Bearings for Electric Motors.

Ball bearings are being used extensively in Germany for small and medium sized motors. Some interesting figures taken from actual consumption tests are given in the accompanying table, for which we are indebted to the *Electrician:*

	Motor Running at		
	No Load.	Half-Load.	Full-Load.
(1) Three-phase motor, ¼ h.p., 950 revs. per minute. Saving in energy over same motor with plain bearings.....	50%	19%	11%
(2) For a three-phase motor, 3 h.p. and 1,500 revs. per minute, the corresponding figures.....	45%	12%	6.5%
(3) For a three-phase motor, 30 h.p. and 750 revs. per minute, the corresponding figures are	30%	5%	2.5%

A one-half horse-power three-phase motor running at 1,500 revolutions per minute was tested, first without and then with counter-shaft, all bearings being of the ball type. The following efficiencies for half and for full load respectively were obtained: (1) Without counter-shaft, seventy-seven and seventy-eight per cent, respectively; (2) with counter-shaft, seventy-three and sixty-nine per cent, respectively.

Annual Meeting of the Society for the Promotion of Engineering Education.

Joint Session Held with the American Institute of Electrical Engineers.

THE annual meeting of the Society for the Promotion of Engineering Education was held at Niagara Falls, July 1 to July 3, 1903. The first session was called to order at 10 A. M. Wednesday, by President Calvin M. Woodward, of St. Louis. The report of the treasurer, Arthur N. Talbot, was read, and it was announced that twenty new members had been elected to the society.

President Woodward then delivered his address. This was a discussion of the value of manual training for technical students, and a plea was made for more general instruction in these subjects in high schools.

Professor Charles F. Burgess reported for the Committee on Technical Books for Libraries. The report gave a list of technical subjects in branches of engineering and science, and included a list of some 350 books thought to be suitable. It was suggested that this list be revised yearly, the committee working together with the American Library Association.

The second session was called to order Wednesday evening by President Woodward, at 8 P. M. A paper by Mr. Arthur W. Ayer, of Philadelphia, was read by Professor Arthur N. Williston. This called attention to the growing importance of technical education, and offered some suggestions which the author thought would be an improvement. Particular stress was laid upon the value of business training.

In the discussion the value of business training was admitted, and it was stated that some work in this is being given in a number of technical schools, but it is impossible to carry it far. The question of what work should be left out to make room for this work was asked.

Professor J. P. Jackson, of State College, Pennsylvania, read a paper on "Methods of Study for Technical Students." The author advocated the group system, the students being encouraged to work together, and related his own success with this method. In the discussion some difference in opinion was shown as to the value of this method of study, it being generally thought that the strong man would profit most, and the weak man least, by group study.

THURSDAY, JULY 2.

The morning session was called to order by President Woodward at ten o'clock. The report of the secretary, Professor Clarence A. Waldo, of Lafayette, Ind., was read.

Professor F. C. Caldwell, of Columbus, Ohio, read a paper on "The Rating of Laboratory and Classroom Work in Schedules of Courses." This discussed the desirability of an understanding of the proper rating to be given to classroom and laboratory work.

A paper by Professor Arthur N. Williston, of Brooklyn, N. Y., was read by the author. This was entitled "Two Kinds of Specialization and Fundamental Principles, In Place and Out of Place." This paper discussed the trend in all lines of work toward specialization, and disproved the stand of the society against this. Special courses are useful where a group of persons desires training in certain lines of work.

In the discussion it was pointed out that in many cases lack of funds prohibits this, and that students frequently do not know what they wish to do.

In reply, Professor Williston said that the small schools could get over the difficulty of lack of funds by offering but one course and adhering to that.

Professor Hugo Diemer, of Lawrence, Kan., read a paper entitled "Education Preparatory to Factory Management." Owners of engineering works have expressed themselves as being in great need of technically educated young men who have the capacity and training to fit them for positions which are executive to a greater or less degree. There is here a branch of productive industry in which there are wide opportunities for life service, and it is the duty of the engineering school to give heed to these claims of the manufacturers.

In the discussion the question was asked, how time is to be secured for this instruction? Some speakers thought that this work did not belong properly to the technical schools.

Papers by Professor Walter H. Drane, Oxford, Miss., entitled "Education in the Southern States," and by Professor S. Henry Barraclough, of the University of Sydney, Australia, on "Progress in Technical Education in Australia," were read by title.

Professor A. H. Blanchard, of Providence, R. I., read a paper entitled "Engineering Jurisprudence an Essential in the Engineering Curriculum." The study on engineering jurisprudence by technical students is advantageous because of the knowledge required, for the insight gained into business relations and methods, due to a cultivation of respect for strict legal clauses in specifications, and on account of the development of reasoning power and independent thought. The course should extend throughout the senior year, one hour per week.

In the discussion the advisability of giving instruction in this work was recognized, but some speakers expressed the opinion that sufficient time was not allowed for the course.

The Thursday evening session was called to order at eight o'clock by the president. The election of the following officers for the ensuing year was announced: President, J. Frank Allen, Boston, Mass. Vice-presidents, Charles L. Crandall, Ithaca, N. Y.; James C. Nagle, of College Station, Tex. Secretary, Clarence A. Waldo, La Fayette, Ind. Treasurer, Arthur N. Talbot, Urbana, Ill.

A communication was read from Professor J. L. Van Ornum, of St. Louis, Mo., upon recent tests on cement.

Professor Walter M. Riggs, of Clemson College, S. C., read a paper entitled "The Equipment of an Electrical Engineering Laboratory." This paper was illustrated by lantern slides, and described the equipment which had been found satisfactory at this institution.

Professor A. F. Ganz advocated a lecture course in laboratory methods before taking up laboratory work.

A paper by Professor J. A. L. Waddell, of Kansas City, Mo., on "The Advisability of Instructing Engineers on the History of Their Profession," was read by Secretary Waldo. The author deplored the ignorance of students and young engineers in the history of their profession, and stated that there was at present no satisfactory book on the subject. He proposed that the society appoint a committee to consider the advisability of the society undertaking the writing and publication of the history of civil engineering, using the latter term in its broad sense so as to cover all branches of engineering except the military. Some suggestions were made concerning the proposed work. It should cover all branches, and it would probably be advisable to have different topics written or compiled by different engineers. A number of communications on this paper was read. The greater part of these expressed warm approval of the undertaking; others did not think it advisable for the society to go into the matter. Not all agreed with the author on the ignorance of engineers in regard to their profession.

Resolutions were adopted thanking the American Institute of Electrical Engineers for its courteous invitation to meet in joint session the following day, July 3, and for its hospitable entertainment. The society then adjourned to meet in joint session with the American Institute of Electrical Engineers on Friday.

The proceedings of the Friday morning session will be found in the report of the convention of the American Institute of Electrical Engineers.

SWISS VERTICAL TURBINES.

BY FRANK C. PERKINS.

Among the hydroelectric plants abroad having a fall of less than ten metres and using vertical turbines, may be mentioned the Stadtisches Elektricitatswerk Aarau and those at Brugg, Wynau-Langenthal and Luterback-Solothurn.

The Aarau plant is of that construction utilizing vertically driven alternators directly-connected on the shaft of the turbine similar to the method used at Niagara Falls, but of course with much shorter shafting on account of the low head. The other plants, while employing vertical shaft turbines, use electrical generators with horizontal shafts and either transmit the power to the dynamos from the turbine shafts by bevel gearing, as at the Wynau-Langenthal installation, or utilize belt transmission from countershafts as at the Brugg and other plants. The horizontal turbine has many advantages over the vertical turbine, especially when generators of the horizontal shaft type are to be employed, on account of the great simplicity and the absence of troublesome gearing. Where it is desirable from special conditions met with to use vertical turbines, the vertical shaft generators are of great convenience in simplifying the installation.

At the Brugg plant there is a fall of

VERTICAL TURBINE AND WHEEL CASE.

2.38 metres and the discharge is 6,330 litres per second per turbine. There are two Rieter turbines installed at this plant, each having a capacity of 150 horse-power. They are of the slow-speed vertical type, operating at thirty-three revolutions per minute. They are employed in driving five direct-current generators by belt transmission and are controlled by special automatic governors designed by John Jacob Rieter & Company, of Winterthur, Switzerland. The electrical machines were built by the Elektricitats-Actiengesellschaft, formerly Schuckert & Company, of Nurnberg. A third turbine has been installed at this plant of the Francis type, which has a capacity of 260 horse-power, the effective head being increased to 3.12 metres and the speed to fifty-one revolutions per minute. This turbine passes 8,300 litres of water per second.

At the Luterbach-Solothurn plant,

THE VERTICAL TURBINES AT THE WYNAU-LANGENTHAL, SWITZERLAND, PLANT.

owned by the Aare-Emme-Kanal-Gesellschaft, there are in operation six Rieter turbines working under a head of only 1.8 metres. These vertical turbines drive by belt transmission six generators, built by Brown, Boveri & Company, of which five are alternating-current machines and one is of the direct-current type. The vertical turbines run at a speed of only thirty revolutions per minute and pass 8,660 litres of water per second, delivering a total of 696 horse-power or 116 horse-power each.

At the plant of Geizner, Mutter & Company, at Bludenz, Autriche, there are five vertical turbines of 300-horse-power capacity, working under a head of nine metres and discharging 3,240 litres of water per second. The vertical turbines at the Wynau-Langenthal plant are geared directly to the five alternating-current machines by bevel gearing. The two exciters and the five alternators were constructed by Siemens & Halske, of Berlin, Germany. The turbines driving the exciters run at a speed of ninety-six revolutions per minute, the head being four metres and the discharge per turbine 3,000 liters per second. These machines have a capacity of 120 horse-power each. The main turbines of the Rieter type develop 750 horse-power each or a total of 3,750 horse-power, the discharge being 18,800 litres of water per second per turbine and the speed 41.5 revolutions per minute.

There are two vertical turbines at the Aarau plant, directly connected to vertical alternators, built by Brown, Boveri & Company, of Baden, Switzerland. The Rieter turbines work under an effective head of four metres, and develop 400 horse-power each at a speed of forty-eight revolutions per minute. The water discharge for each turbine is 10,700 litres

VERTICAL TURBINE.

per second. The canal supplying the water for the power station at Aarau is 2,400 metres long, and carries at low water 23.3 cubic metres of water. Of the three turbines installed, the smallest one

has a capacity of 200 horse-power and is utilized by the Cementfabrik Fleiner.

The vertical alternators are two-phase machines and supply a current of 2,000 volts pressure and a frequency of forty periods per second. The power transmission lines carry the current to Aarau, a distance of one kilometre, and both lighting and power service is supplied.

It is claimed by many prominent engineers that the efficiency of the vertical turbine may be made considerably higher than that of the horizontal turbine, although it would seem that the efficiency and power of both should be approximately the same. The advantages are many times in favor of the horizontal shaft turbines, on account of the case with which the turbine shaft may be extended, and pulleys be utilized for the transmission of the power at a higher or lower speed. The horizontal turbine may be designed for all heads—high, low and medium—and those constructed at Winterthur are of the Girard, Pelton, Francis, Rieter and American types.

Bath Electric Tramways, England.

The British Westinghouse Electric and Manufacturing Company, Limited, is now executing a contract for the Bath Electric Tramways, Limited, London, which well serves to indicate the position which the former company is now taking in general contracting work. The contract in question includes the building of the generating station and car sheds: also the supply, delivery, and erection of the entire equipment for the two buildings, in accordance with designs prepared in conjunction with the engineers of the Bath Electric Tramways Company.

The generating station equipment is to consist of three 200-kilowatt, Westinghouse generators, direct-connected to horizontal, tandem-compound engines, and one seventy-five kilowatt generator direct-connected to a compound steam engine. Two fifteen-kilowatt negative boosters are to be supplied, with a twelve-panel switchboard, of the Westinghouse tramway type, as well as such other auxiliary apparatus as is involved in a tramway generating station.

The boiler house is to be equipped with three 10,000-pound Babcock & Wilcox straight tube, water-tube boilers, and a Clay Cross economizer; surface condensers are to be used, and also a complete equipment of water-softening and grease-separating apparatus.

The car shed is to have a capacity of forty double-deck, fifty-six-passenger cars. On the second floor and across the front of the car sheds are to be located the offices of the company.

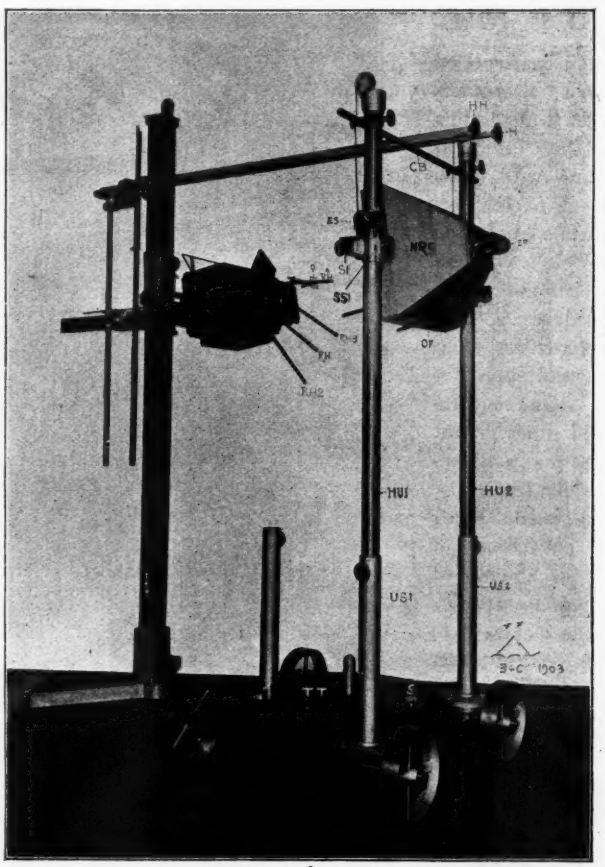
The rolling stock is to consist of forty cars, the bodies and trucks being of the Milnes make, and Westinghouse equipments. Most of the cars will, at the outset, be equipped with the Westinghouse magnetic brake, which should be found particularly useful on the Bath system, because of the large number of severe gradients.

NOTES ON X-LIGHT.

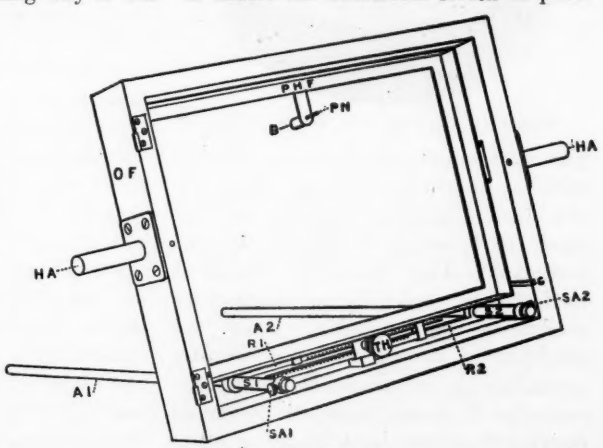
BY WILLIAM ROLLINS.

NOTE CLXII—A WAGON FOR X-LIGHT EXAMINATIONS.

I use the term wagon to emphasize the fact that the support for the patient is on wheels. In note cxv, March 9, 1901, I showed the importance of this plan in X-light examinations, stating why it was superior to the universally employed method of a fixed support. The plan here mentioned of mounting a patient on an axis that he may be turned in a horizontal plane and providing a graduated circle for indicating the amount of rotation is not claimed as original. It has been used by Williams for examining a patient in a sitting position in an office chair, elevating with a screw. For examining a patient's chest from the front, I prefer the standing position, as his knees and the arms of the chair make the sitting position inconvenient, therefore the X-light wagon here described is arranged not only for a sitting but also for a standing position. The wagon is furnished with a turn-table (TT, Fig. 1) which has the usual graduations, and is provided with a stop, S, which holds it in any position when a photograph is to be made. The base of the wagon and the turn-table are made of hard wood, cross-glued in three layers. There are four wheels, each thirty-six centimetres in diameter. The wheels may be deemed larger than necessary. The size was chosen to enable the movements of the wagon to be easily made by one hand during an examination, that the relative positions of the source of light and the patient might readily be changed without removing the eyes from the image on the screen. To the wagon base three upright metal sockets are attached. Two of these, US 1 and US 2, hold two metal tubes, HU 1 and HU 2, which support the frame, OF, holding the inner frame, PHF, Fig. 2, for the plate-holder and fluorescent screen. The frame, OF, can be turned about a horizontal axis to enable the fluorescent screen or photographic plate to be tilted from a vertical position when necessary to bring either closely against the patient. Usually in examining the chest from the front, the

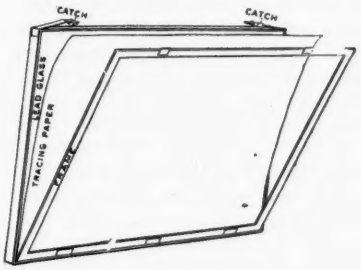


NOTE 162—FIG. 1.



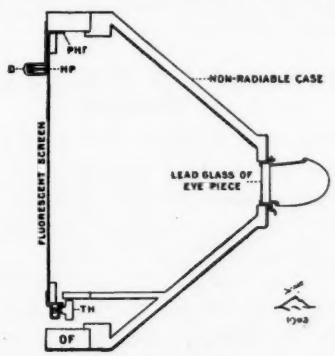
NOTE 162—FIG. 2.

top of the fluorescent screen needs to be tilted back, as shown in Fig. 1. The frame can be swung to one side by sliding back the socket, SI, or removed by also sliding back a similar socket on the other



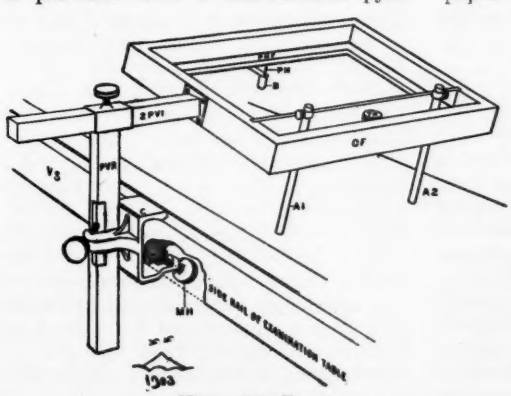
NOTE 162—FIG. 3.

side. The supports, SS 1 and a similar one on the other side, slide on the uprights to enable the frame to be adjusted to any height, where it will remain without clamping, as it is balanced by weights within the uprights. Clamping screws



NOTE 163—FIG. 4.

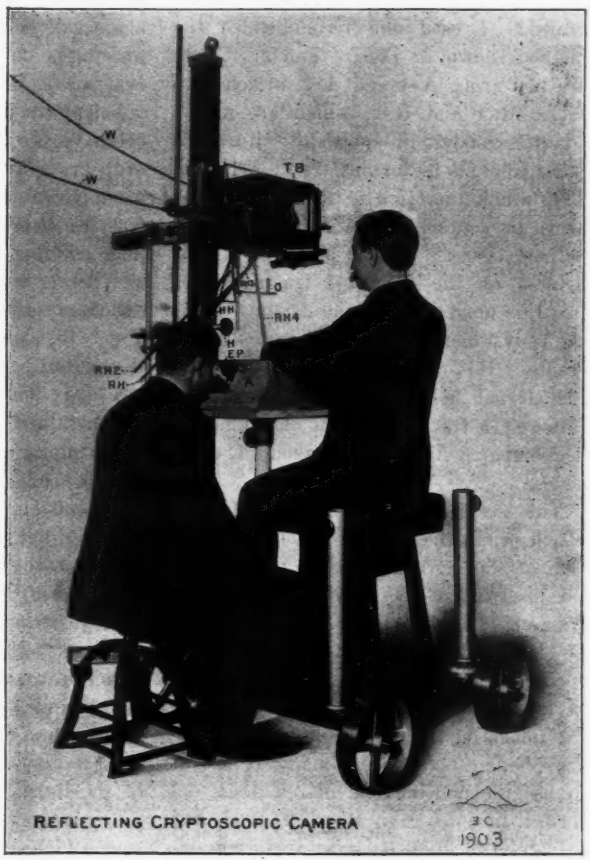
are provided for preventing movement during photographic exposures. A back support for the patient can be attached to the extra sockets, ES and a similar one on the other side. The frame, OF, is provided with a non-radiable pyra-



NOTE 162—FIG. 5.

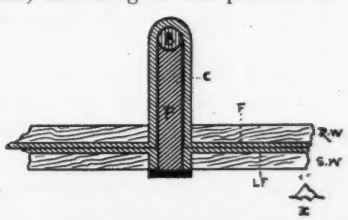
midal case, NRC, which has the same non-radiable eye-piece shown in earlier notes. This case can be turned back or entirely removed as it is attached to the frame, OF, by separable hinges. For examinations with the screen this case is convenient, as the room need not then be very dark. For photography it has the advantages mentioned in note clv. In making tracings of the organs the case, NRC, may be entirely removed, the room being dark, or an opening may be made in the side and provided with a sleeve for the insertion of the hand bearing the tracing pencil. If the screen is used without the case, it must be covered by a plate of heavy lead glass to prevent the X-light from injuring the eyes of the observer. This protection of the eyes is a point which is neglected. I frequently mention it, as my experiments on animals showed that the light could produce blindness. Over the glass is placed the tracing paper or cloth in the usual manner. I hold the glass and the tracing paper in a frame, shown in detail in Fig. 3. To compare one tracing with another, we have only to see that the image of my orienter occupies the same position on the screen in every case and that a tracing of its image on the screen is made on the paper when the shadows of the organs are sketched. To maintain a definite relation of the tracing paper to the patient I designed for Dr. Williams a frame, PHF, shown in detail in Fig. 2. It is of metal of proper size to receive either or both the fluorescent screen and plate-holder, or the fluorescent screen and the glass plate, either with or without the tracing cloth. There is a boss, B, of polished metal which fits into the sternal notch of the patient, a definite and easily distinguished point in the anatomy which is therefore satisfactory as a base station. The boss is hollow containing a spring-actuated needle, PN, which pricks a hole in the tracing paper, thereby indicating on the tracing the position of the base station, from which all measures of the tracing should be made when we wish to compare one with another.

To ensure that the tracing paper always occupies the same position in relation to the patient at every examination, it is also necessary to have some other reference points which may well



NOTE 162—FIG. 6.

form a triangle with the base station. The idea of using the nipples for reference points as is done in percussion may be definite enough for so inaccurate a method, but I discarded it when Williams showed by X-light that one could not determine accurately the outlines of an enlarged heart by percussion. I found the distance between the nipples in a woman of normal form varied several centimetres, according to the position of the



NOTE 162—FIG. 7.

body. In X-light examinations we expect the lines obtained by tracing to be capable of comparison within three millimetres. What was needed was some convenient method of indicating on the tracing paper the position of the medial

line of the body, as this should be the line from which all transverse measures are taken, all vertical measures being referred to the pin prick showing the position of the sternal notch. But how was the medial line to be accurately determined? I used and recommended the method shown in Figs. 1 and 2. There are two arms, A 1 and A 2, attached to racks, R 1 and R 2, which are moved simultaneously in opposite directions equal amounts by turning the milled head, TH, which therefore serves to bring the arms in contact with the sides of the patient's chest. If now a medial line is printed on the sheets of tracing paper this line must indicate the medial line of the body when the tracing paper is in the frame, PHF, provided the boss, B, is in the sternal notch. If this procedure is followed, a tracing made at one time can be compared with those taken at other times.

The needle point already mentioned, which pricks the paper to record the position of the sternal notch, would prevent the insertion of the plate-holder into the frame if it was fixed, but it is forced back by the plate-holder into the boss, B, springing forward when the plate-holder is removed. If we do not wish to examine the image on the fluorescent screen while the photograph is being made, it is best to use the non-radiable plate-holders described in notes cxvi, March 9, 1901, and cxl, June 21, 1902. Under these circumstances the pyramidal hood, NRC, Fig. 1, can be turned back or removed, as the non-radiable back of the plate-holder protects the plate from the diffused and transformed light. If, on the contrary, we wish to see the organs while the exposure is being made, the back of the plate-holder should be of radiable material, the fluorescent screen being placed between it and the observer. Stray light being prevented from reaching the plate by the hood, NRC, which is closed over the plate-holder, the observer looking into the eye-piece, EP, to see the image on the screen.

Of course, I am aware that the projection of the images of the organs on a flat surface distorts them and that observers have recommended making the tracings on the skin and transferring the lines to the tracing paper, which is made to conform to the surface of the skin. This method is not practical with a woman of normal shape, as the breasts prevent it being accurate. As there is a necessary distortion if the source of light is stationary, the slight increase produced by the method recommended is not of serious importance; as for each patient the amount is fixed and therefore introduces no element of confusion. If we wish to avoid all distortion we must have the screen and tube move simultaneously, as has been done by Moritz. The future alone will determine which method is of most use. If we do not use the fluorescent screen in the non-radiable cone provided with a non-radiable transparent eye-piece, we should cover it with a sheet of heavy glass (which will also serve as a support for the tracing paper) to protect the observer's eyes from the X-light. The arrangement is shown in Fig. 3.

Whether the observer uses the direct vision cryptoscopic camera, NPC + OF, Fig. 18, or the glass-covered open fluorescent screen, he has within reach six handles (shown in the figure) which allow him, in connection with the rolling motion of the X-light wagon, to make the necessary adjustments in the position and quality of the X-light, and by means of the break shown in the illustrations to note cxxxix he can control the quantity. H raises or lowers the source of X-light. HH moves it toward or away from the patient. RH regulates the size of the area illuminated. RH 2 and RH 3 centre the opening of the diaphragm and the orienter with the central ray. RH 4 controls the quality of the light.

In addition to the use of an X-light wagon for examining the head, neck, shoulder or chest of a patient in a sitting or standing position, it is useful for photographing the hand, forearm, elbow and upper arm. For these purposes it is provided with one of my reflecting cryptoscopic cameras, similar to those illustrated in note clv. This camera can be placed at different heights above the floor of the wagon.

For photographing the hands for my method of anthropometrical signalment by X-light the turn-table, TT, Fig. 1, is removed. The person to be signalized is seated on a stool with the camera in front (Fig. 6), the hands' palms down resting on the fibre top. The light is then adjusted until the image of the central tube of the oreinter is seen on the screen within the camera between the thumbs, opposite the first joints. In taking the forearm, wrist, elbow or upper arm the patient should be at the side of the camera which is brought to the proper level. Directions for the use of a camera of this type are given in note clv. The cross-bar, CB, Fig. 1, which holds the uprights parallel, also serves as a support for the patient's hands, thus bringing his arm out of the field when examining the chest from the side, which is necessary in studying the heart, as Williams' triangle, thus brought to view, is of an important diagnostic point.

The frame, OF, with all it contains can be removed from the X-light wagon and attached to the examination table shown in earlier notes. The mechanism for this purpose is a modification of that illustrated in note cxxxix for supporting a plate-holder with a non-radiable back. I show it in Fig. 5. VS is a piece of the side rail of examination table. The milled head, MH, presses the rail into the corner of the clamp, C, holding it securely, yet permitting of immediate removal when desired. A similar milled head also clamps the vertical arm, PVR, and this in turn carries another arm, 2 PVR, holding the frame, OF, which can be turned about a horizontal axis to allow the screen or plate-holder to rest against the patient's chest. Thus tracings or photographs can be made with the patient in a horizontal position, the patent being relieved of all unnecessary weight, as this is supported by the rail of the examination table. Full details of the various positions in which this type of mechanism permits a plate-holder to be held were given in the note mentioned.

The Telephone Line Between London and Belgium.

Mr. George W. Roosevelt, United States Consul at Brussels, writes as follows, under date of June 10, 1903: The new telephone line between Belgium and London was opened to the public June 7. The exact length of the finished line, which connects St. Margaret's Bay, England, with La Panne, Belgium, is 87,000 metres (54.058 miles) and the cost of laying was 750,000 francs ($144,750). By this service, Antwerp and Charleroi will be conected with twelve English cities and towns, Brussels with sixteen, and Ghent, Malines and Termonde with eleven. Liege, Verviers, Bruges and Ostend will have communication only through Brussels. Localities in the United Kingdom to be shortly included in the service are Birmingham, Brighton, Bristol, Cambridge, Cardiff, Derby, Ipswich, Sheffield, Southampton, Leicester, Lowestoft, Newport, Norwich, Nottingham and Yarmouth.

The cable is of British make and is composed of four wires, permitting the establishment of two distinct circuits. The thickness of the cable is five and one-quarter inches and the wires are insulated by three coats of chemical composition and by gutta-percha, and are wound on a cable made of tarred flax. The whole is covered by two layers of specially prepared cotton, separated by a copper band. On top of this again a layer of flax acts as a protector, and finally the whole is enclosed in galvanized-iron wires, prepared in a special way and encased in two layers of flax tightly wound in opposite directions.

The tariff for using the telephone is ten francs ($1.93) for three minutes' conversation.

A RATIONAL TRAIN RESISTANCE FORMULA.[1]

BY JOHN BALCH BLOOD.

1. In the early days of train resistance formulæ, when speeds were not high, the frictional resistance of track and journals was a considerable factor in the total resistance. Again, the head resistance was charged up to the locomotive, without a formula, and train resistance meant the pull on the engine drawbar.

These facts, together with the fact that the criteria of industrial competition were loosely drawn, made a simple formula the desideratum, and we see as a result formulæ of many varieties containing a single variable.

These served their purpose at the time, but time and advancing knowledge showed their inadequacy both as to absolute results and functionally. The immediate needs were supplied by sets of formulæ with different coefficients and variables, each good only for a certain range.

The original single-term formulæ were of two kinds, as follows:

$$R = A + BM \qquad (1)$$

$$R = A + CM^2 \qquad (2)$$

Where R = train resistance in lbs. per ton,
M = speed of train,
A, B and C = coefficients.

2. The development from these formulæ showed a desire for a rational formula, the elements of which would represent distinct parts of the resistance recognizable and measurable. Experiments and the gradually increasing train speeds began to indicate the different elements of resistance, although the function and absolute value of each was not obtained.

The higher normal train speeds brought out the fact that a factor of the resistance was the air friction, and that it certainly varied as a function of the speed greater than unity, and in all probability as the square.

3. In 1885, the Eastern Railway, of France, made some very extensive experiments and gave as its results a set of formulæ of a rational type, using different coefficients for different ranges of speed. Its formula was of the type

$$P = (A + BM)\,T + CQM^2 \qquad (3)$$

Where P = total pull or horizontal effort,
M = speed,
T = weight of train,
Q = cross-section of train,
A, B and C = coefficients.

This reduces for comparison with other formulæ to

$$R = A + BM + \frac{CQM^2}{T} \qquad (4)$$

It will be noted that for trains with a speed of twelve to thirty-two kilometres per hour, the engineers left off the last term having the speed-factor as the square, leaving a formula of the form (1).

This formula (4) is interesting from a rational standpoint. First, it has two terms with variables; one as the first power of the velocity, and one as the second power of the velocity. Second, the second power-factor has a component, the cross-section of the train. This would show that this factor was to give the air resistance, and would show that they appreciated that there was another part of the resistance that was not constant, and yet it did not vary as the square.

4. Their set of formulæ, instead of a single formula, showed that their variables were not functionally correct, and must be modified by variation of the coefficients.

The set of formulæ as given by them is as follows:

(*a*) For freight trains speeds twelve to thirty-two kilometres per hour.

$$W = (1.65 + 0.05\ v)\ Q.$$

(*b*) For passenger trains speeds thirty-two to fifty kilometres per hour.

$$W = (1.8 + 0.08\ v)\ Q + 0.009\ Av^2.$$

(*c*) For passenger trains speeds fifty to sixty-five kilometres per hour.

$$W = (1.8 + 0.08\ v)\ Q + 0.006\ Av^2.$$

(*d*) For express trains speeds seventy to eighty kilometres per hour.

$$W = (1.8 + 0.14\ v)\ Q + 0.004\ Av^2.$$

Where W = resistance of train in kilogrammes,
Q = weight of train in tonnes of 1,000 kilogrammes,
V = speed in kilometres per hour,
A = cross-section of trains (5 qm.).

These formulæ were very accurately constructed from careful and exhaustive experiments, and the variation in the coefficients will serve to indicate the functional inadequacy of the variables.

There are four points to be observed in the variation of these coefficients. First, that the factor independent of the speed was apparently constant at all speeds. The deviation from this in case of freight trains could probably be accounted for by the construction of the car or the relative weight of load per axle. Second, it will be seen that the coefficient of the first power-factor is increased as the speed increases. Third, that the coefficient of the second power term is decreased with increased velocity. And fourth, that the second power term is eliminated from the low-speed formula.

5. From these observations we would draw the following conclusions: that there is a portion of the train resistance that is independent of the velocity; that the air friction-factor has little or no influence below thirty-two kilometres. These seem to be clear.

The increasing of the coefficient of the first power term and the decreasing of the coefficient of the second power term indicate an empirical attempt to adjust the coefficient to take care of improper functional value of the variables.

We find a single variable formula with first power-factor gives too small results for high speeds if it is correct for low speeds. We find, also, that a single variable formula with a second power-factor gives too high results at high speeds if it is correct at low speeds. This would seem reasonable, as it is apparent that there are at least three forms of friction—plain sliding friction, which is independent of the speed; rolling friction, which varies directly as the speed; and fluid friction, which, in case of air, would vary theoretically as the second power of the speed.

6. It seems, then, perfectly reasonable that a rational formula should have these three terms. Experience shows that while a formula having three terms of zero, first and second power variables, respectively, will give accurate results for a wider range than either of the single variable formulæ, it in common with the second power single variable formula gives too large results at high speeds, if it is correct at the lower speeds.

This is apparently what the engineers of the Eastern Railway, of France, found, and they tried to counteract this by reducing the effect of the second power at higher speeds by reducing the coefficient, and by increasing the effect of the first power term at higher speeds by increasing its coefficient. It would seem that the increase of the relative moment of the first power term at high speeds was palliative only, rather than that the rolling friction did increase in greater ratio than the first power.

The conclusion to draw from the above is, that the third term of the equation should have an exponent greater than one and less than two.

7. In March, 1899, I presented in the

[1] A paper presented at the Saratoga meeting (June, 1903) of the American Society of Mechanical Engineers, and forming part of vol. xxiv of the *Transactions*. For further references on this subject see *Transactions* as follows: No. 924. vol. xxiii, p. 269, "Cost of Running Trains at High Speed."

Street Railway Journal a rational formula with a third term having an exponent of 1.8, giving reasons somewhat as above to substantiate its reliability. The formula expressed in the same terms as above was:

$$R = 4 + 0.15\,M + 0.3\,\frac{M^{1.8}}{T} \qquad (5)$$

Mr. W. J. Davis gives a formula which gives very accurate results below forty or fifty miles, but it is generally acknowledged that it gives too high results at higher speeds. The formula is:

$$R = 6 + 0.13\,M + 0.25\,\frac{M^2}{T}\,[1 + 0.1\,(N - 1)] \qquad (6)$$

Mr. Davis gives different coefficients for different sizes of cars, but does not vary them for the speed. The large cars would naturally be used at the higher speeds, so that the coefficients, if adjusted to the higher part of the curve for the larger cars, would give a series of curves with better total results, but would not be any more functionally correct than the French formulæ.

8. There is a point in rational formulæ which is very important; namely, that the terms for head and stern resistance have in the denominator a factor proportional to the length or weight of the train. This appears in many formulæ, and is reasonable when it is considered that the head and stern resistance would be independent of the length of the train, and, therefore, when expressed in pounds per ton, would be inversely proportional to the weight or length. In most formulæ the weight is used rather than the length. This would give as a prinicple that the head and stern resistance, which varies as a power of the speed between one and two, should have a weight-factor in the denominator.

It has been found by experiment that the air resistance on the sides of the cars varies as power of the speed higher than the first. It is evident that this factor of total resistance should be proportional to the length or weight of the train, and therefore in our form of formula would have no weight-factor in the denominator.

The head and stern resistance can be divided if it is desired. It is found in actual practice that the head resistance is much larger than the stern resistance. Professor Goss's experiments on models show that this head resistance is 6.5 times the stern resistance, and that the head and stern resistance together are about 6.2 times the side resistance of one car.

From collateral evidence it would seem that the coefficient of the variable in the side resistance term should be considerably lower than that of the head resistance term. The air, in case of the side resistance, is not compressed, but is sheared off, and the fluid particles are dragged aside rather than piled up on each other.

On the basis of the above, the rational formula would be:

$$R = A + BM + CM^n + D\,\frac{M^p}{T} + E\,\frac{M^p}{T} \qquad (7)$$

Where R = resistance in pounds per ton,
M = speed in miles per hour,
T = weight of train in tons,
n = exponent of side friction term,
p = exponent of head and stern friction terms,
A = coefficient for sliding friction,
B = coefficient for rolling friction,
C = coefficient for side air resistance,
D = coefficient for head air resistance,
E = coefficient for stern air resistance.

Now, we have not yet enough data for determining the proper exponents, nor to seperate the exponents into the two forms. Again, as there are always two ends to a string, the head and stern resistance will always come together.

Until we find sufficient evidence to give us the two exponential factors, we will be better served to combine all three exponential factors into one. Again, for general work this would be simpler and sufficiently accurate. We would then have:

$$R = A + BM + \left(C + \frac{D}{T}\right)M^n \qquad (8)$$

9. This is essentially the formula given by me in 1899, the only difference being in the coefficient of the exponential term separating out a factor representing the side resistance, which is proportional to the train weight.

Where R = resistance in pounds per ton,
M = speed in miles per hour,
T = weight of train in tons,
n = exponent = 1.8,
A = coefficient of sliding friction,
B = coefficient of rolling friction,
C = coefficient of side resistance,
D = coefficient of head and stern resistances.

The values of these various coefficients are as follows:

A = 3 for heavy freight trains.
A = 4 average passenger trains.
A = 5 heavy large electric cars.
A = 6 medium electric cars.
A = 7 light electric cars.

B = 0.15 for light track construction.
B = 0.12 for heavy track construction.

C = 0.0016 for ordinarily constructed cars.
C = 0.0014 for cars with vestibules.

D = 0.25 for small cross-section cars.
D = 0.30 for medium section electric cars.
D = 0.35 for large electric or suburban trains.
D = for largest express trains.

As our experimental data are increased, it will be possible to correlate these coefficients more intimately with the elements of friction they represent.

The foregoing has shown the gradual development of the train resistance formula from a rational standpoint. It, however, has been viewed all along from the start from an empirical standpoint.

10. When it was found that a formula with a single variable term was insufficient, there were those who refused to add another term to the formula, contending that such term did not give an absolute formula, and only extended its range if results were at all in advance. Again, the range of increased alleged accuracy was within the range of variation in the value of the coefficients, so that altogether the extra complication was not worth the result. These advocated an empirical formula taking such range for each separate set of coefficients as experience would warrant.

There were others, I believe, who were led to abandon the rational formula on account of intellectual cowardice. They found that a single variation formula was hopelessly inadequate with either the first power or the second power. After having passed to the three-term formula with first and second power variables, they saw that with the increase of speed and shortening of trains, too high results would be obtained at high speeds. They balked at following the natural and logical course of reducing the exponent of the second power term, arguing, perhaps, that complication of the fractional exponent was not warranted; also, perhaps, being led by the fact that the theoretical air resistance is known to vary as the second power.

11. Let us consider the uses of a train resistance formula. Originally, it served more as a guide than an engineering hypothesis. As skill in design and application increased, more and more attention was paid to the fitting of machines

to the work they had to do. Moreover, with steam railroads and long trains, extreme accuracy was not essential, as one or more cars could be added or taken off as conditions required.

With the advent of short suburban trains with three to five cars, short distances between stations and a demand for increased schedule speed, it became very necessary to fit the motive power with a nicety to its work. In case of a three-car train, if the locomotive was too small, the taking off of a single car would reduce the train weight thirty-three per cent, and then the locomotive would be too large, besides necessitating a change in the time tables.

This need was still further emphasized by the high speeds of such trains as the Empire State Express, of the New York Central & Hudson River Railroad, and also by the high-speed interurban electric cars. In case of these electric cars, the motive power of each car being on its own axles, there is no possibility of adjustment if it is not suited to its work.

It will be seen, then, that the use of train resistance formulæ has changed from that of a general guide to that of a fundamental engineering criterion. Extreme accuracy is now a desideratum, functional as well as absolute.

Again, the complication of the number of terms and the fractional exponent is not the drawback that it would appear, as the use of such formulæ now takes the intermediary of charts or curves, eliminating all complication of calculation. Moreover, the general use of the slide-rule makes a fractional power practically as easy of calculation as the integral factor.

Those who argued for the empirical formula pretty generally stuck to the single variable formula, and varied the coefficients to suit the case. There were those who, finding the two variable formulæ inadequate, apparently went on an empirical excursion to find some form which would give accurate results for a wider range than given by existing formulæ. The formula of Mr. John Lundie is of this class, and as stated by him is:

$$R = 4 + 5\left(0.2 + \frac{14}{35 + T}\right),$$

which, reduced for comparison with rational formula, becomes

$$R = 4 + 0.20\,M + \frac{14M}{35 + T} \qquad (9)$$

The third term of this equation can not be explained rationally. The depreciated reciprocal weight-factor has no rational analogy in practice. This formula has all the complications of a three-term formula, without the advantage of rational formula.

12. Mr. J. A. F. Aspinall, the general manager of the Lancashire & Yorkshire Railway, has gone into the matter of train resistance in an exhaustive manner, and presented in November, 1901, at a meeting of the British Institution of Civil Engineers a paper on the subject. He gave as a results of his study and experiments for a five-car train:

$$R = 2.5 + \frac{V^2}{57.8} \qquad (10)$$

Where R = resistance in pounds per ton of 2,240 pounds drawn,
V = velocity of train in miles per hour.

He found that for a greater number of cars that the length entered as a factor and gave

$$R = 2.5 + \frac{V^2}{50.8 + 0.0278\,L} \qquad (11)$$

Where L = length of train in feet.

It will be noticed that the independent coefficient is small. It can generally be taken as a fact that when the independent factor is less than three the formula is empirical, and that the independent coefficient is reduced to compensate some other error introduced. In all formulæ this independent factor represents the resistance just before coming to rest, and is the minimum obtainable resistance. This is seldom less than four pounds, and only in exceptional cases goes below 3.5 pounds.

Mr. Aspinall has the courage to go to a fractional exponent. He, however, combines all variables into one term, thereby cutting loose from a rational formula. He has also a depreciated reciprocal length-factor, which is comparable with Mr. Lundie's depreciated reciprocal weight-factor. Mr. Lundie has a third term with the first power variable alone, which Mr. Aspinall has not.

Although I am a believer in a rational formula, I was pleased to see Mr. Aspinall's fromula, as he is the first man to give, other than myself, a fractional exponent of the variable.

Mr. C. O. Mailloux recommends an empirical formula, and one of the form

$$R = A + BM^n \qquad (12)$$

Now, mathematically, this equation can be made to very closely represent any curve with a constantly increasing function and, therefore, can be made to represent any given test curve, probably, within the limits of accuracy. If a curve be plotted representing a given set of readings, and a curve of form of equation (12) be plotted to represent such curve, if the highest points of the two curves coincide, it will be found that the empirical curve cuts the real curve at two points, and that the values of the resistance as calculated from the empirical curve beyond the upper limit are higher than the true values. It is very important in extending curves to have all points determined as accurately as possible, for a slight variation in direction is magnified by the amount of extension. That this empirical curve would give high results on the extension is obvious when it is considered that a factor varying as the first power of the velocity is eliminated and its place taken by an augmented coefficient of the higher power-factor. At low values of the speed, the difference between the true value of the first power variable and its substituted higher power-factor would probably be within the limits of accuracy of observation, but this is not so at high values, and would always lead to high results. This empirical train resistance formula is good to represent a given series of results for mathematical or functional comparison. It, however, is of little, or, perhaps better stated, inferior value for predicted results of extension beyond the highest value of observation. It is very important for extending the curve that the first power-factor be present and accurately determined as to its coefficient.

13. Another important point which the empirical formulæ entirely leave out is the relative value of the different portions of the resistance. In a rational formula it will be seen that the side air resistance comes within the limits of accuracy at about thirty miles per hour, and the head and stern resistance become negligible for a six-car train at about the same speed; but for a single-car train, they do not become negligible till you get down toward twenty miles per hour. It would seem this is a very important function of a train resistance formula. It would seem, in conclusion, that all arguments favor the rational form rather than the empirical form, and that the highest exponential variable should have a fractional exponent between one and two.

Condensing engines require from twenty to thirty times the amount of the boiler feed water, for condensing purposes. An approximation, for estimating purposes, is one and one-quarter gallons condensing water per minute per indicated horsepower. It is usually estimated that a condenser will decrease the fuel consumption by from twenty to twenty-five per cent.

A FORM OF MAGNETIC DETECTOR FOR HERTZIAN WAVES, ADAPTED FOR QUANTITATIVE WORK.[1]

BY J. A. FLEMING.

The normal power of electrical oscillations to demagnetize iron or steel was first applied in the construction of a detector of Hertzian waves by Mr. E. Rutherford. The power possessed by electrical oscillations to annul the magnetic hysteresis of iron was discovered by Mr. G. Marconi, and applied by him in the construction of a sensitive Hertzian wave detector for use in wireless telegraphy. As is well known, very slight differences in the nature of the spark or the spark balls in a Hertzian oscillating system cause immense differences in the radiating power; but there has been no instrument which could indicate and measure exactly the intensity of the radiation. Although the coherer is quite sensitive, it is of little value for quantitative measurements. On the other hand, the magnetic detector is not only superior to the coherer in sensitiveness, when properly constructed, but is capable of being used as a measuring instrument. In the form in which it was constructed by Rutherford, an extremely fine bundle of iron or steel wires was magnetized by means of a magnet, or by being placed in the interior of a solenoid; then demagnetized by an electrical oscillation passing through another coil surrounding it. The amount of demagnetization was detected by a magnetometer.

After trying various forms, the author found the following to be the most satisfactory: A pasteboard tube about three-quarters of an inch in diameter and five or six inches long was surrounded with six coils of No. 40 silk-covered copper wire, each containing about 6,000 turns. These coils are joined in series, and have a resistance of about 6,000 ohms. In the interior of the tube are placed eight small bundles of iron wire about six inches in length, each bundle being composed of eight wires of No. 26 S. W. G., previously well paraffined or painted with shellac. Each bundle of wires is wound over uniformly with the magnetizing coil formed of No. 36 silk-covered copper wire in one layer; and over this, but separated from it by one or two layers of gutta-percha tissue, is wound a single layer of No. 26 wire, forming a demagnetizing coil. This last coil is, in turn, covered over with one or two layers of gutta-percha.

The magnetizing coils are connected in series with one another, so that when a current passes through the whole of them it magnetizes all the bundles in the same sense. The outer or demagnetizing coils are joined in parallel. In addition to this coil there is a rotating commutator, consisting of a number of hard fibre discs, secured on a steel shaft driven by an electric motor at about 500 turns a minute. There are four of these discs, and each has let into its periphery a strip of brass, occupying a certain angle of the circumference. The brass sector of the first disc occupies ninety-five degrees of the circumference. The brass sectors of the second and third discs occupy 135 degrees of the circumferences, and that of the last disc, 140 degrees. Brass brushes make contact with these discs, and serve to interrupt or make electrical circuits as they revolve. The function of the first disc is to make and break the circuit of the magnetizing coils placed around the bundles of iron wire, thus applying a magnetizing current during a portion of one period of rotation of the disc, leaving them magnetized during the remaining portion. The function of discs two and three is to short-circuit the terminals of the secondary coil of the bobbin during the time that the magnetizing current is being applied by the first disc. A sensitive movable-coil galvanometer is employed in connection with the secondary coil, one terminal of the galvanometer being permanently connected to one terminal of the secondary coil, and the other terminal connected through the intermittent contact made by the fourth disc. This disc is set so that during the time the secondary coil is short-circuited, and while the battery current is being applied to magnetize the wires, the galvanometer circuit is opened.

During one complete revolution the operation goes on as follows: First, the magnetizing current of a battery of secondary cells is applied to magnetize the iron bundles, and during the time that this magnetizing current is being applied, the terminals of the fine-wire secondary coil are short-circuited, and the galvanometer is disconnected. Shortly after the magnetizing current is interrupted, the secondary bobbin is un-short-circuited, and an instant afterward the galvanometer circuit is completed and remains completed during the remainder of one revolution. If, during the period when the galvanometer is connected to the secondary coil, an electrical oscillation is passed through the demagnetizing coils, an electromotive force is induced in the secondary bobbin by the demagnetization of the iron, and causes a deflection of the galvanometer. Since the rotation of the commutator is rapid, these impulses produce a continuous deflection of the galvanometer which is proportional to the demagnetizing force being applied to the iron. The instrument can be employed as a telegraphic receiving instrument, or it can be used to verify the law according to which variation falls off with distance. Its chief use would be for comparing together the wave-making power of different radiators. For this purpose the oscillation coils must be connected to two long connecting wires, or one end may be connected to the earth and the other to a vertical aerial.

It is thought that this instrument will be of great value in the design of radiators and transmitters for Hertzian-wave wireless telegraphy. The instrument may be made as large as desirable, but it is necessary that the iron wires be quite small, and that they be assembled in small bundles. It is also necessary to short-circuit the fine-wire secondary coil, as described above, during the time of magnetization of the core.

[1] An abstract of a paper read at a recent meeting of the British Royal Society.

Wireless Telegraphy in Guadeloupe.

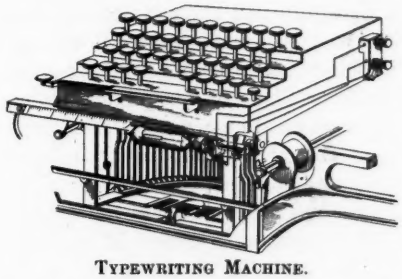
Consul L. H. Aymé, of Guadeloupe, under date of June 10, 1903, says: The wireless-telegraph system in operation between this island and Martinique has been thrown open for the use of the public. Messages are transmitted from this city and other points to the station at Gosier by telephone. The tariff of rates is practically that of the French Cable Company, the lines of which have been broken for some sixteen months. The service is satisfactory, an average of sixty messages each way being transmitted daily. There are, of course, occasional interruptions, due to weather conditions, but these are not frequent.

Uses of the Telephone.

In the course of a recent lecture on telephony, Mr. F. C. Raphael stated that at the present time there were more than a quarter of a million subscribers and about 1,100 exchanges in Great Britain. He explained how subscribers could utilize their telephones for a number of purposes, of which the majority of subscribers were ignorant; as, for instance, telephoning telegrams, express letters, and even ordinary letters to post offices. In the latter case, thirty words can be telephoned to a post office for transmission as an ordinary letter for an extra charge of one penny in addition to the ordinary charge for postage; and telephoned express letters are delivered at the ordinary express fee (threepence per mile) from the post office without extra charge.

Electrical Patents.

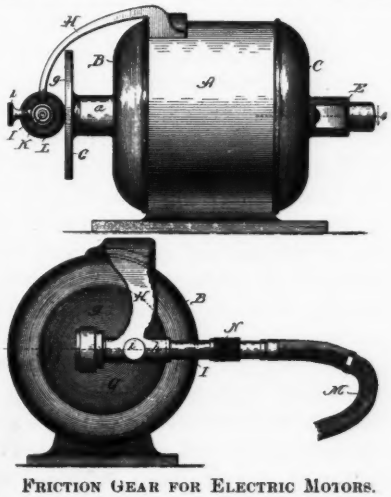
Hiram J. Halle, of Cleveland, Ohio, the president of the Fisher Book Typewriter Company, of Cleveland, Ohio, has just obtained a patent on an electrical lighting attachment for typewriters that is both novel and useful. While the attachment is being employed with success and is particularly adapted for use on the Fisher typewriter, the invention is



TYPEWRITING MACHINE.

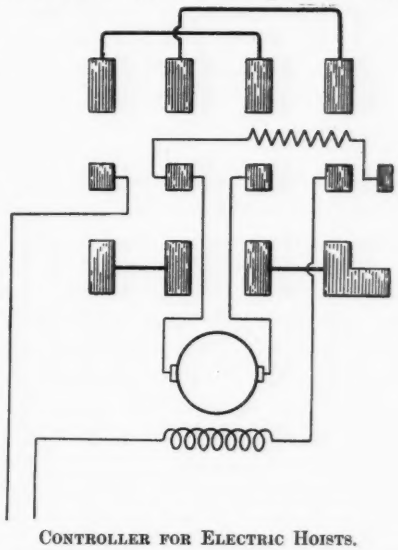
not limited in scope to this particular machine. The object is to provide an illuminating device, designed to illuminate the work sheet for the purpose of facilitating the inspection of the work. It frequently happens, particularly in large establishments, that typewriting machines are located at points where it is impossible to secure sufficient light and this is particularly true of typewriters, wherein the machine is located over the paper to be written upon, thus cutting off from the work a considerable portion of the light. As is well known, the Fisher typewriter includes in its organization what is known as a "traveling carriage," carrying the type bars and movable over a flat platen arranged beneath the same and supporting the flat sheets or pages to be written upon. The printing mechanism includes a segmental supporting ring in which the type bars are journaled, and as these type bars strike downwardly toward the axis of the type ring, the printing point is in full view of the operator. During the printing operation, however, the line being written upon is obscured by the ribbon, which extends under the type ring from the opposite sides of the carriage. Means are employed for shifting this ribbon away from the line, so that such line will be exposed when it is desired to inspect the same. The means include a rock shaft, having connections with the ribbon spools and ribbon guides, this rock shaft carrying a suitable key located in convenient relation to the operator. Thus, when the key is depressed, the ribbon will be shifted rearwardly. A small electric lamp of the incandescent type is secured to the frame of the machine above the printing point and is so arranged that the light therefrom will fall upon the line being printed, though it is cut off by the frame from the eyes of the operator. This lamp is in a suitable electric circuit, which also includes a switch comprising a pair of contact devices, one of which is attached to the rock shaft of the ribbon shift, the other being fastened to the lamp. The arrangement of these contact devices is such that as long as the ribbon is over the line being printed the lamp circuit will be broken, for the light will not be needed, but when it is desired to inspect the work, the depression of the key, as already stated, will cause the ribbon to move rearwardly away from the line. This movement will rock the shaft and bring the contacts into engagement, thereby closing the circuit and lighting the lamp. As soon as the ribbon is permitted to move back to its operative position, the lamp is extinguished. If, however, the operator desires a continuous light, a separate switch is employed having suitable connections with the lamp and the source of electrical energy, so that a circuit may be made which when closed by the switch will keep the lamp constantly illuminated.

A simple friction gear for electric motors has been devised by Mr. Julius B. Wantz, of Chicago, Ill., and the patent obtained thereon is controlled by the Victor Electric Company of the same place. The mechanism can be employed for driving any light machine or tool wherein the speed and power transmitted may be readily and quickly varied without changing that of the motor itself. The armature shaft of the motor is provided with a yielding thrust bearing at its inner or rear end, comprising a ball bearing against the end of the shaft and a spring bearing against the ball. The outer end carries a friction disc journaled upon the motor casing or frame, and extending at right angles to the face of the disc is a longitudinally adjustable shaft carrying a friction wheel that engages the disc, the bearing or gripping pressure between the same being effected by the yielding thrust bearing.



FRICTION GEAR FOR ELECTRIC MOTORS.

A controller for electric hoists devised by Philip J. Darlington, of Glen Ridge, N. J., has been purchased by the Sprague Electric Company, of New Jersey. The invention is designed to provide for the controlling of electric hoisting motors, such as are used on traveling cranes or on



CONTROLLER FOR ELECTRIC HOISTS.

stationary hoists. When used on traveling cranes, the crane consists of a bridge mounted on wheels on elevated supporting-rails and carrying a traveling truck or trolley on which the hoisting motor is mounted. The bridge may be substituted by a boom, in which case suitable provision should be made for bracing and supporting it, or the hoisting motor may be mounted on a stationary support without any traveling bridge or trolley. The hoisting motor is series-wound and is adapted to rotate forward and backward, as desired, for hoisting and lowering the load. When used for hoisting, it will generally suffice to have a controller with only one forward position; but in lowering the load it is very desirable that the controller should be arranged so that with heavy loads the descent shall not be too rapid and that the motor shall not be caused by the load to run away. The inventor has devised for this purpose an efficient controller in which there are four positions—an off or open-circuit position to bring the motor to rest, a hoisting position, and two lowering positions, one of which provides for fast running, while the other provides for slow running by shunting the armature of the motor with a resistance in the shunt. In lowering a heavy load the operator moves the controller to the fourth position, either immediately or after it has been for a time in the third position, and in this way the motor is caused to run slowly and too rapid lowering is prevented. He also combines the controller with a brake, which when the controller is in off-position is automatically applied to the motor and stops it.

Reviews of Current Engineering and Scientific Literature.

On Hertzian Waves in Wireless Telegraphy.

When oscillations are produced in a simple antenna using a spark-gap connected in the circuit, the antenna vibrates in quarter waves, but the length of the wave produced depends upon the electrical constants of the conductors. It then becomes necessary to select a conductor which will give the maximum vibratory effect. A method of doing this is described here by M. G. Ferrié. To determine the wavelength of the oscillations produced, a horizontal wire is connected to the antenna at a point between the oscillator and the earth. In this wire a hot wire ammeter is connected. The indications of this instrument will be proportional to the amplitude of the oscillations. Bv varying the length of the horizontal wire, the amplitude of the oscillations will vary between maxima and minima. The maximum vibrations will occur when the wire is in tune with the oscillations. In this way the experimenter can determine the fundamental note, as well as the harmonics. A table is given showing some actual results of an experiment of this character.—*Translated and abstracted from l'Electricien (Paris), June 27.*

The Real Inventor of the Mercury Coherer.

This short article by M. Emil Guarini gives a review of the facts connected with the invention of the mercury coherer. This coherer was used by Mr. Marconi for his first transatlantic experiments in September, 1901, and the statement was made at that time that it was the invention of Lieutenant Solari, of the Royal Italian Navy. This, however, was denied by the latter. Following this, an article appeared in *l'Elettricita* (Milan) stating that the coherer had been invented by Signor Castelli, of the Royal Italian Navy. It now appears that the true inventor is Professor Tommasina, a distinguished savant of Geneva, well known for his interesting experiments and researches in connection with wireless telegraphy. The latter, in a note to the *Comptes Rendus* (Paris), of May 1, 1899, on the production of electrolytic chains and deposits, said: "In my researches relating to coherers with single contact, after having obtained very sensitive ones by means of a drop of mercury placed in a glass tube between two brass electrodes of cylindrical shape . . . " Again, in an article appearing in the archives of a Geneva society, dated May 3, 1900, Professor Tommasina mentions, among different decohering coherers, a coherer consisting of a drop of mercury between two carbon electrodes. This article was abstracted in *l'Elettricita* (Milan) in its issue of July 7, 1900, just at the time the Italian Navy was making experiments with the Marconi system. It seems highly probable that those engaged in this work noticed the article, and tried the coherer described there.—*Abstracted from the Electrician (London), June 19.*

A Proposed Transmission for Pumping Purposes.

In this article, Mr. Lewis A. Hicks considers the development of the Kings River to furnish power for irrigation of the lines between Fresno and Hanford in California. The site selected for the power-house is at the junction of the south and middle forks of the Kings River at an altitude of 1,980 feet. The diversion planned is from the middle fork through 14,000 feet of continuous tunnel, delivering a maximum flow of 182 feet at the penstock, which is 680 feet above the water-wheels. The watershed tributary to this diversion contains an area of 325 square miles. The minimum flow occurs in September and during the rest of the year is never less than 100 cubic feet per second. The power available here has been shown to be ample to furnish a maximum of 328,500 acre-feet required annually by the pumping plants. Ordinarily the water is very clear, but provision has been made for trapping the sand brought through the tunnel. Details of the penstock and the tracks which give a movable flashboard, will make it possible to flush a settling chamber without interfering with the continuous flow of the conduit. From the settling chambers three pipe lines, thirty inches in diameter with full load velocities of seven feet per second and an effective head of 660 feet, deliver the water to Pelton wheels. Each pipe feeds one generating unit, but a thirty-inch by-pass connecting the three pipes makes it possible to feed two units in any one of the three pipe lines. The generators proposed are of the three-phase, sixty-cycle, revolving field type, with a normal capacity of 1,350 kilowatts at 2,200 volts at a speed of 200 revolutions per minute. This voltage is raised to 30,000 by static transformers and the lines follow the wagon roads as far as possible. To handle the large amount of water delivered by the wells fifty-horse-power induction motors are proposed, operating at 2,000 volts. One transformer station is to be installed for four pumping plants. The substations will contain 200 kilowatts of self-cooling oil-insulated transformers. The station building has a double wall to provide ample ventilation. The pump motors are to be mounted on a vertical shaft driving a centrifugal pump, the latter is designed to carry the weight of the motor when in operation. The motor is started empty and the pump is primed by closing the gate valve on the discharge pipe and exhausting the air from the suction pipes and pumps with a mechanical primer operated with a taper friction from the motor-shaft. The estimate for the cost of this development is, for the hydraulic works, $289,499; for buildings, bridges, etc., $85,888; electrical equipment, $92,705; transmission lines and substations, $343,950; 100 pumping stations, $425,985. Allowing five per cent for contingencies, the total cost will be $1,278,629. The estimated cost of operation is $157,611. This would make the cost per acre-foot per annum about fifty cents. This figure is considerably less than that given for a number of other irrigating systems.—*Abstracted from the Journal of Electricity, Power and Gas (San Francisco), June.*

The New Electricity Works of the Manchester Corporation.

This is a description of the largest electric power distribution undertaking in Great Britain. The schemes of the Manchester Corporation include the Stuart street generating station, with an output of 9,000 kilowatts and ten substations; a second station at the same place, with an output of 7,500 kilowatts, with nineteen substations; and, in addition to this, the corporation has completed the new works at Bloom street, with a normal output of 7,200 kilowatts, as well as a station on Dickinson street, with an output of 10,350 kilowatts. The total output of the three works existing at this moment is 26,550 kilowatts. When the sets now under construction are completed, the total output will be more than 34,000 kilowatts, about forty per cent more than the Glasgow works, which ap-

pears to be the second in size in Great Britain. The load consists of about 400,000 lamps; 1,000 motors, aggregating about 4,000 horse-power; and 130 miles of tramways, operating 400 motor cars. The Stuart street station, which is here described, generates three-phase alternating current at 6,500 volts, fifty cycles. This is transmitted to substations through underground cables. At the substations the energy is converted, by means of motor-generators, to direct current at 550 volts for traction, and 205 and 410 volts for light and power. The boiler house contains twenty-four Babcock & Wilcox boilers, each capable of evaporating 12,000 pounds of water per hour at a pressure of 200 pounds per square inch. The normal working pressure is 170 pounds. There are six main generating sets, each consisting of a 2,500 indicated horse-power, vertical cross-compound engine, direct-connected to a 1,500-kilowatt generator. Full details are given of the boilers, engines, generators, piping, electrical wiring and accessory apparatus.—*Abstracted from the Electrical Review (London), June 26.*

Electric Lighting of Railway Systems.

This is an article by M. M Soebrier, describing the electric lighting systems employed by the Compagnie des Chemins de fer de l'Ouest. This company is operating a number of stations in the neighborhood of Paris. One of these lights the Saint Lazare station. This is an old plant furnishing current at seventy volts, but on account of the low pressure the system has not been extended, and will soon be replaced by the Moulineux station which is now being erected. The Montparnasse depot is supplied from the Vaugirard station with continuous current at 110 volts. The machines are of the old Gramme type, driven by eighty-horse-power engines. A storage battery equipment of 4,300 ampere-hours runs the lights at times of light load. The service at this depot includes arc and incandescent lights, elevators, electric pumps and other apparatus. The new Moulineux station will supply current for lighting and for power for the railways of the western part of Paris. It is located on the Seine, between the Paris end of the Lazare line and the Champs-de-Mars. The buildings are divided into two sections, one for boiler and the other the generator room. There are nine generating groups in the engine room, each with a normal output of 800 kilowatts, but able to develop 950 kilowatts for thirty minutes, or 1,000 kilowatts for five minutes. Six of the generators are driven by triple-expansion Corliss engines, and the other three by cross-compound Corliss engines. All the generators are revolving field multipolar Westinghouse machines. There are three groups of 125-kilowatt exciters. Power is generated at twenty-five cycles, 5,000 volts, which is transmitted to three substations for the railway lines, and to many others for lighting. The low frequency was selected on account of the railways to be operated, and this introduced a number of problems when used for lighting. Another difficulty was introduced by the many points to be lighted, each requiring but a few lights. In the principal depots arc lamps were necessary, and here motor-generator sets were installed to furnish them with direct current. When but a few lights are required incandescent lamps are used, operated in series from the 500-volt railway circuit. At one of the freight depots a tentative arrangement of arc lamps on the twenty-five-cycle alternating circuit is being tried. These lamps are placed ten metres above the floor, and at this height the flickering is less objectionable. At the substation at Batignolles 5,000-volt induction motors are direct-coupled to 500-volt direct-current machines. Current is distributed for lighting by the three-wire system at 220 volts across the circuits, two 110-volt lamps being connected in series on these circuits. The arc lamps are mounted four or five in series. A balance between the two circuits is maintained by an equalizing group and a storage battery with a capacity of 600 ampere-hours.—*Translated and abstracted from the Revue Technique (Paris), June 10.*

Electrical Traction on the North-Eastern Railway, England.

Additional information has been given out concerning the proposed equipment of the North-Eastern Railway, England, in the neighborhood of Newcastle-on-Tyne. Newcastle is situated eight miles from the mouth of the Tyne. The intervening districts on both banks of the river are densely populated, and contain an almost continuous succession of shipyards, engineering and other works. There is between Newcastle and the sea a large traffic the whole year round. This attains enormous proportions during the holiday seasons. The Quayside branch of this system is for freight traffic only, but this is being electrically equipped on account of the severe grades and the many tunnels. The freight trains of this system, except those of the branch just mentioned, will be drawn by steam. Passenger traffic will be handled electrically. Trains will be operated by continuous current obtained from a single conductor rail, with the return circuit through the running rails. Power will be generated at 5,000 volts, three-phase, forty cycles, and transmitted to substations, where, by means of stationary transformers and rotary converters, it will be transformed into continuous current at 600 volts. The collector rail will be of specially high conductivity steel, Vignole's section, eighty pounds per yard, and carried on insulators composed of reconstructed granite. Current will be supplied to this rail from five substations, located at Pandondene, Wall's End, Collarcoats, Benton and Kenton. Fourteen 800-kilowatt rotary converters will be distributed among the substations, that at Pandondene having the largest capacity, and containing four rotaries. Each converter has been specially designed to operate without serious sparking at an overload of 100 per cent for ten minutes, and an overload of 200 per cent momentarily. The rotaries are started by a small induction motor fed by a special transformer. The unit train will be composed of two motor cars with a trailer between, and, if necessary, will be increased by adding other units. The trains are controlled by the Thomson-Houston multiple unit system. The railroad company will purchase electrical energy from the Newcastle-on-Tyne Electric Supply Company, which is erecting a station at Carville. This new station is to consist of steam turbo-generators of the Parsons type, each of 3,500 kilowatts, with an overload capacity of 5,000 kilowatts for two hours. As the space occupied by such a set, compared with that taken by the boilers necessary to supply the steam, is small, each turbine will have a separate range of boilers running at right angles to the engine room. Every two ranges of boilers will be combined in one centrally fired boiler house, and will be provided with independent flues, economizers, induced draft and an iron chimney. By this arrangement a short, simple pipe system can be secured, and the station can be extended in either direction. Turbine sets will be supplied with steam at a pressure of 200 pounds per square inch, superheated to 500 degrees Fahrenheit. The condensers will be placed directly under each turbine. Plans and elevations of the generating station and substations are given.—*Abstracted from the Electrician (London), May 29.*

An Interesting Wireless Incident.

The whole question of the efficacy of the tuning apparatus which Mr. Marconi employs in his system of wireless telegraphy, has once more been brought prominently before the public by reason of a little *contretemps* which has happened in connection with a lecture given by Dr. J. A. Fleming at the Royal Institution. The object of the lecture was to demonstrate to the audience the wonderful feat of receiving a message into the heart of London, through such a multitude of obstructions, from Cornwall. To all outward appearances the demonstration was completely successful, but the lecturer himself was made painfully aware of the fact that some "enemy" was at work, inasmuch as a number of severely irrelevant interruptions were indicated on his tapes. Wishing to "draw the badger," Dr. Fleming wrote to the *Times* in harsh terms of such, as he called it, "scientific hooliganism," with the result that Mr. Maskelyne, who will be recognized as the author of an article some time back in one of the electrical papers here giving facsimiles of the messages sent from Cornwall to the Italian warship Carlo Alberto, acknowledged himself to be the perpetrator of the "outrage." He claims to have proved beyond all doubt that the Marconi system has not shown itself to be a success, as his experiments from the beginning have been with an ordinary untuned apparatus. On the other hand, the Marconi Company claims that its arrangements have never been specially made with a view to keeping out intruders, and really one can not but help wishing, in the interests of everybody, that some conclusive data were furnished us on the point. The ordinary man on the street, having followed up this controversy from the advent of Mr. Maskelyne, can not help being influenced by the fact that the daily news service to the *Times* from the other side of the Atlantic has been to all appearances dropped, then when Mr. Maskelyne's tapes of the Alberto messages were, in effect, claimed to be forgeries, his challenge to contest the matter was ignored. Now comes this latest instance of interference, with the methods of which, perhaps, every one will not be in agreement. The company appears satisfied that the attempt to wreck the demonstration was unsuccessful, but this is putting a false view of the facts before the public. Mr. Maskelyne did not attempt to, nor wish to, do any such thing. He apparently only desired to demonstrate that interference was possible. On the other hand, Mr. Marconi has a larger number of supporters in Great Britain than is indicated by the expressions of opinions in the newspapers, and these would welcome a final settlement of these problems—if this be at present possible —and consequently a confusion of his enemies. It is the continual refusal to do this and the number of somewhat evasive statements issued by his company which strengthen the hands of his "enemies."

London, June 27. A. W.

The Anglo-Belgian Telephone Cable.

Some particulars are here given of the London-Brussels telephone cable, which was opened June 8. The idea of this cable is by no means new, for experiments have been made from time to time since 1877 on the telephonic cable, but without success. More recently the feasibility of successful telephone cable between England and Belgium was demonstrated by means of the Anglo-French telephone cable, lengthened by overhead lines, so as to represent, as nearly as possible, the conditions under which an Anglo-Belgium cable would have to work. The Dover-Calais cable measures twenty-three nautical miles, while the Anglo-Belgium cable, beginning at St. Margaret's Bay, England, and terminating at La Panne, Belgium, has a length of 47.3 nautical miles. The overall diameter of the cable is fifty-five millimetres and contains four conductors, and was made by Henley's Telegraph Works Company, London. It weighs 7.275 kilogrammes per metre, and costs about $3,000 per mile. Each of the four conductors is of a left-hand strand of seven wires, the weight per kilometre of conductor being 39.7 kilogrammes. At a temperature of seventy-five degrees Fahrenheit, the resistance is less than four ohms per kilometre. The insulation of the wires consists of three layers of gutta-percha, with three layers of Chatterton compound. The weight of one conductor, including its insulation, is approximately 112.3 kilogrammes per kilometre. After being insulated the conductors were placed in water tanks, heated to seventy-five degrees Fahrenheit for twenty-four hours, then subjected for fifteen minutes to an alternating-current of 5,000 volts at 100 cycles per second. The cable was then tested for insulation and capacity with a 300-volt battery. The insulation resistance specified was 500 megohms and the capacity for the same length 0.275 microfarad. The four conductors are grouped round a tarred hemp core 7.5 millimetres in diameter, and the same material is used for filling up spaces between the conductors. Then follows a layer of cotton tape, prepared with ozokerite, next is the usual brass protection consisting of a brass tape one millimetre thick by thirty-eight millimetres broad. Over this is another layer of cotton tape, then a covering of the best tanned Russian hemp. This is followed by the metallic armor, consisting of sixteen galvanized iron wires, each 7.1 millimetres thick. These wires are heated with pure gas tar before application. The cable is wound with two reverse layers of hemp. It is laid in three sections and crosses the Anglo-Belgian telegraphic cable in deep water. After laying it was tested for resistance and capacity at 46.5 degrees Fahrenheit. The resistance of the four conductors varies from 331.2 to 331.5 ohms. The capacity of the wires varies from 12.617 to 12.575 microfarads. The total length of the London-Brussels telephone circuit is 394.3 kilometres, 150 being overhead lines in Belgium, and 156 overhead lines in England. The overhead lines are all of hard-drawn copper, weighing about 800 pounds per mile.—*Electrician (London), June* 12.

New Substation for Union Railway Company, New York.

The Union Railway Company, of New York city, is building three new substations in the vicinity of New York city; one at West Farms, one at Mount Vernon and the other at Yonkers, all of which are to be equipped with Westinghouse apparatus exclusively. They will be operated by the large power station at Kingsbridge, which is owned by the Interurban Street Railway Company, having been built by Westinghouse, Church Kerr & Company, of New York, and the Westinghouse Electric and Manufacturing Company, of Pittsburg, Pa. The substation at West Farms will contain nine 375-kilowatt, oil-insulated static transformers, divided into three groups, supplying current to three 600-kilowatt rotary converters. The switchboard consists of high-tension, alternating-current, receiving panels with electrically operated oil circuit-breakers, low-tension, alternating-current rotary panels and load panel, with direct-current rotary panels and load panel; also about twenty direct-current feeder panels.

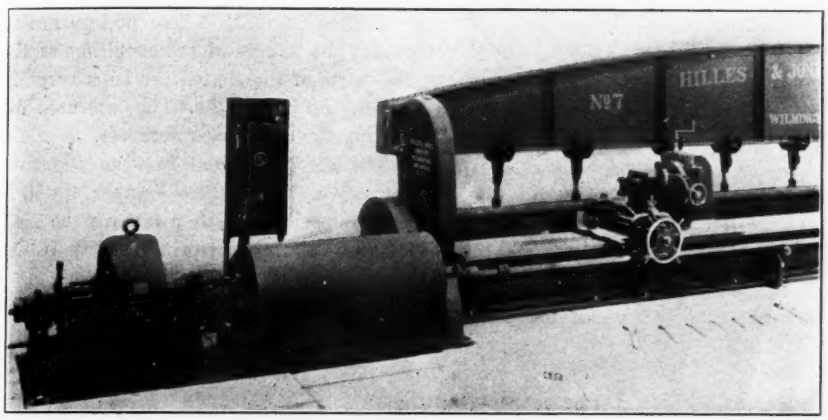
The other two substations, now in course of construction, will have similar equipments, excepting that the capacity in each case will be three 500-kilowatt units instead of three 1,000-kilowatt units. The entire equipment for each substation is being furnished by the Westinghouse Electric and Manufacturing Company.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Motor-Driven Plate Planer.

The attached illustration shows a thirty-two-foot, heavy plate planer built by Messrs. Hilles & Jones, of Wilmington, Del., and recently installed in the United States Navy Yard at Charlestown, Mass. Direct-connected to the main driving screw of the planer, through gearing and magnetic clutches, is a fifty-horse-power, Westinghouse, multipolar motor of 220 volts and running at slow speed, which furnishes ample power to enable the machine to plane two-inch armor-plate, taking a heavy chip. A thorough test proved the machine to be a powerful tool in every respect.



MOTOR-DRIVEN PLATE PLANER.

The saddle of the planer is designed to carry two tools, one cutting in each direction, also a third tool for vertical feed, the saddle and tool holder being shifted automatically at any point desired.

Test Methods in Steam Turbine Construction.

At a recent meeting of the Electric Club, of Cleveland, a paper was read by Mr. Edwin Yawger, in which he described the testing of material and turbines as carried out by the Westinghouse Machine Company in developing the Parsons turbine. The author called attention to two classes of testing. One he designated as scientific, and the other empirical. The first class of testing is that made on machines and material with the intention of obtaining information useful for design and construction. The second class is a test to which the machine is submitted when it is put out into actual service, and the results of this test indicate the reliability of the machine. A noteworthy test of this kind was made by the company when it installed a 1,600-kilowatt plant in the works of the Westinghouse Air Brake Company, and operated this for four years.

At the testing laboratory organized by the company tests of material are carried out chemically, mechanically and microscopically. Mechnical tests are made on sample specimens of all the large forgings and on the material for all the smaller forgings, from time to time. In the chemical laboratory tests are made of all the materials used in turbine construction, and microscopic examinations are made of samples of the materials used. This latter test frequently shows a marked difference between two specimens which have the same chemical composition.

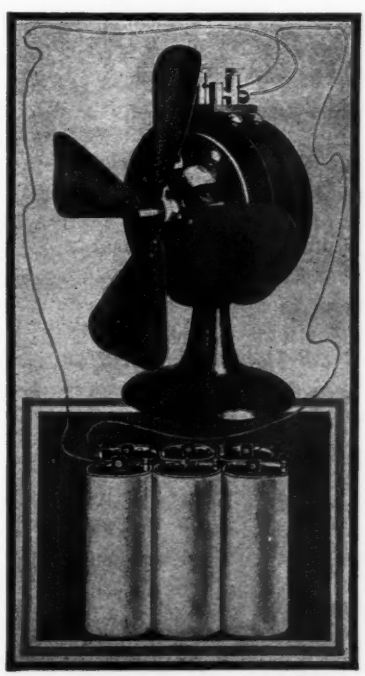
In order to test the turbines a laboratory has been arranged which provides space for four 5,500-kilowatt machines at one time. There is a large superheater by which the steam can be superheated 200 degrees. Two condensers and the accompanying pumps maintain a vacuum of twenty-eight inches. When the turbine is connected to a generator it is most conviently tested by measuring and absorbing the output of the generator. For this purpose a water rheostat containing 165 square feet of electrodes and a water capacity of 1,200 gallons has been provided. When a brake test of the turbine is desired it is coupled to a water dynamometer. This consists of a short cylindrical chamber in which revolve one or more discs. Water is admitted to the chamber near the axis, and escapes through one or more of a series of outlets placed at various distances from the axis. The power absorbed is varied by varying the depth of the water in this chamber.

Tests of various sizes of Parsons turbine were shown, and attention was called to the uniform efficiency of this type of prime mover under widely varying loads.

In the discussion, in which Messrs. Benjamin, Hoag, Sperry, Ballard and Langley took part, it was brought out that the efficiency of the turbine increases with an increasing load until the limit of the machine is reached. It then slows down. Steam is admitted to the turbine in puffs, and regulation is effected by increasing the duration of these puffs. The operating valve is driven from a worm-gear at a speed from one-twentieth to one-tenth that of the turbine. The weight of these turbines for an equivalent output is about one-third that of an ordinary compound engine. The efficiency of the larger units is better than that of the smaller ones, but the difference is not so marked as is the case with reciprocating engines. The advantage gained from condensing is much greater with a turbine than with a reciprocating engine.

Dry Battery Fan Motor.

The Ewing-Merkel Electric Company, 1106 Pine street, St. Louis, Mo., has placed on the market a new seven and one-quarter-inch dry battery fan motor. This is well shown in the accompanying illustration. The motor is equipped with six dry cells and will run for 200 hours without renewing. As may be seen from the illustration, the fan motor closely follows the design of the larger apparatus.



DRY BATTERY FAN MOTOR.

While being built substantially and constructed in a most thorough manner, the price is exceedingly low. The dry cells are of the ordinary type, and if at any time new cells are required, these may be secured at almost any supply house.

An Electric Express Annunciator.

Mr. J. H. Rusby, of Nutley, N. J., is placing on the market an express annunciator, an illustration of which is shown in the accompanying engraving. The operation of this annunciator is decidedly simple, and consists essentially of a fulcrumed lever, one end of which meshes with a semi-circular gear segment. This lever is placed between two opposing electromagnets. The electromagnets are connected in the circuit of an on-and-off push-button, the manipulation of either attracting the lever to the charging electromagnet. The action of the lever in moving toward the charging electromagnet is to throw the painted signal either up or down, through an arc of ninety degrees. These annunciators are made in any desired length, the width always being the same, but the length varying with

ELECTRIC EXPRESS ANNUNCIATOR.

the number of signs affixed in the cabinet.

The device is designed for use in warehouses and commercial establishments which will find it necessary or convenient to manipulate their express-calling signs on the sidewalk from the shipping clerk's desk within the building.

A Thermo-Call Button.

The accompanying illustrations give a good idea of a new device which the American Thermo-Call Company, 12 Pearl street, Boston, Mass., is placing on the market. This thermo-call is adapted for use in private dwellings, hotels, factories, steamboats, warehouses, etc.

The device combines the ordinary push-button now in general use with an automatic fire-alarm. As may be seen from the illustration, the thermo-call consists of the ordinary push-button apparatus, to which is added a thermostatic coil and an adjusting screw. Both the ends of the thermostatic coil and the adjusting screw are platinum-tipped, ensuring a long life and a perfect contact whenever occasion makes this essential. The thermostatic coil is made of a peculiar alloy, and is so adjusted that it will give an alarm over a wide range of temperature, varying from zero to 400 degrees. The combination push-button and thermostat is placed in every room, and may be installed in the same circuit as the ordinary push-button and annunciator service now

COMBINATION CALL BUTTON AND THERMOSTAT.

existing in hotels and dwellings. The push-button service may be utilized to test the circuits every day, indicating on the annunciator wherever any trouble may be found. If the temperature of the surrounding atmosphere should, at any time, reach that for which the thermostat coil is set to indicate, the alarm is promptly given by the circuit closing automatically. This is in no way a fusible device, the contact being made mechanically, and when the apparatus cools down to the normal the circuit is automatically broken. Where the thermostats are located on the ceiling or in places where a push-button is not desired, a small cap is fitted over the apparatus, making the thermostat positively dust and moisture-proof.

The manufacturer claims to have brought this device to a high state of perfection, as a delicately sensitive instrument for indicating a dangerous temperature; and numerous tests have demon-

THERMOSTAT FIRE-ALARM.

strated the fact that the most incipient fire will be discovered in time to bring it entirely under control without suffering any loss.

Mechanical and Electrical Equipment of a Cotton Mill.

The mechanical and electrical equipment of the cotton mills of the Davis Mill Company, at Fall River, Mass., is in many ways up to date, including a fan-and-heater system of heating and ventilation, induced draft in place of a chimney and electrical motor-drive throughout. To provide flexibility in the boiler plant and ensure against shutdown, the induced-draft plant has been installed in duplicate. Two seven-foot blast-wheels, running in three-quarter, steel-plate housings, are driven by centre-crank, horizontal engines. The fan-wheels are overhung in the housings and are furnished with special wide, water-cooled bearings. The engines themselves are provided with extended shafts upon which a pulley is mounted between each fan bearing the respective engines. These pulleys are in reality the flanges of the couplings of the two parts of the shafts, the belts running directly on the flanges. They are used for driving the economizer scrapers.

The air connection between the fans contains a flat swinging damper, which is so arranged that either fan can be shut off and the other run separately if desired. The outlet connections are likewise provided with dampers and the operating attachments are so placed that both can be changed at once by hand. The engines receive steam at eighty pounds and are furnished with a balanced valve which can be used in connection with a damper regulator.

The heating plant of the Davis mills is a duplicate of that installed at the Arkwright mills some years ago. It consists of a large exhaust-wheel drawing air through a steam-pipe heater. The fan-wheel is provided with one tight and two loose pulleys and the engine has an extra wide, flat-face flywheel for shifting the belt. A second belt connects the fan pulleys with the line-shafting of the mill. This arrangement makes it possible in the summer time to run the fan from the line shaft, thus taking advantage of the economy of the large mill engine, while in the winter, when the exhaust of the fan engine can be utilized in the heater, or at night when the large engine is not running, the fan is driven by the fan engine.

The heater is built up of one-inch pipe, erected on cast-iron sections which rest at one end on ball bearings to allow for expansion and contraction. It is so arranged that the exhaust steam from the engine can be used entirely in one group of sections, making it possible to condense all the exhaust before it is necessary to use any direct steam, which is added at a reduced pressure when necessary. The outfit also includes a Kendall receiving-tank, with a water gauge and a safety valve, and a duplex Worthington steam pump. The heating apparatus

will heat the mill to seventy degrees Fahrenheit when the temperature outdoors is zero.

The electrical equipment consists of two belted direct-current generators, one of fifty kilowatts and one of seventy-five kilowatts, operating at 125 volts, no load, and compound-wound. These generators supply current for lighting and for a twenty-seven horse-power motor and one of forty-three horse-power. The oiling devices of the motors are so arranged that they can be hung from the ceiling. The above apparatus has been furnished by the B. F. Sturtevant Company, of Boston, which also designed and constructed the heating and ventilating and mechanical draft plants.

Stone Pipe for Underground Conduits.

The American Stone Conduit Company, Chicago, Ill., is the manufacturer of an underground conduit that is increasing greatly in popularity with electrical and contracting engineers. American stone conduit is made in single duct,

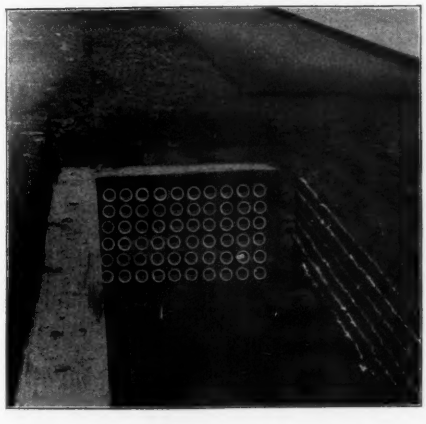


FIG. 1.—TERMINATION OF A 60-DUCT SUBWAY.

FIG. 2.—A SUBWAY SYSTEM IN CINCINNATI, OHIO.

six-foot lengths, four and one-half inches in diameter, with a three and one-eighth inch bore. Crushed lime-stone and the best quality of Portland cement are used in its production. In the process of manufacture the conduit is subjected to an interior pressure of thirty-five pounds per square inch, giving great strength to its walls, and a highly polished inner surface. Displacement taking place from the interior gives a smoothness which is of great advantage.

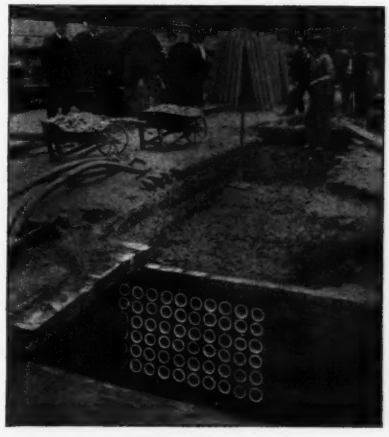


FIG. 3.—SUBWAY SYSTEM IN CINCINNATI, OHIO.

Several of the accompanying illustrations show portions of a 400,000-duct-foot underground conduit system constructed

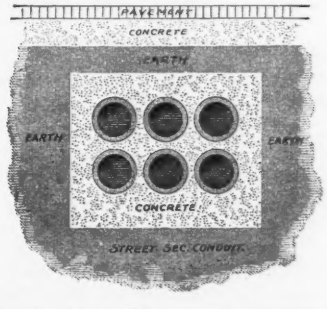


FIG. 5.—STONE CONDUIT CONSTRUCTION.

with American stone conduit in Cincinnati, Ohio. The termination of a sixty-duct system at the manhole is shown in Fig. 1. Figs. 2 and 3 are other illustrations of this installation. Fig. 4 details the method of construction, and Fig. 5, the method of making joints. The process of laying this conduit system is very simple. Under ordinary conditions the bottom of the trench is concreted to a depth of from two to three inches. The conduit is then laid on this surface, with one-half inch of Portland cement concrete firmly packed or tamped between the ducts as laid in the subway. By the use of the mandrel which is supplied by the company, a joint is formed that is practically self-aligning and perfect. If more than one horizontal row of ducts is to be laid in the same trench, the top of the first row is covered with one-half inch of concrete, and the work is continued in the same manner until the required number of ducts has been laid. The space between the sides of the trench and the outer ducts is filled in with from two to three inches of concrete, and the system is completed with a top layer of the same amount of concrete.

The rubber mandrel, which is shown in Fig. 5, fits the bore of the conduit snugly, is placed directly at the joint of the conduit, and while in that position concrete or grout is packed firmly around the joint and along the conduit to the next joint. The mandrel is then brought forward and the work continued in the same manner.

FIG. 4.—PATENTED RUBBER MANDREL.

Journal of the Western Society of Engineers.

The June issue of the *Journal* of the Western Society of Engineers contains several interesting articles. Among these may be mentioned one by T. L. Condron, on "Specifications for Material and Workmanship for Steel Structures." Mr. Richard McCulloch contributes a few notes on European tramways, in which he describes some of the features of the English, French and German street railways. A paper by Mr. W. B. Jackson, on "Hydraulic Developments as Related to Electric Installations," discusses points which must be considered in developing water power.

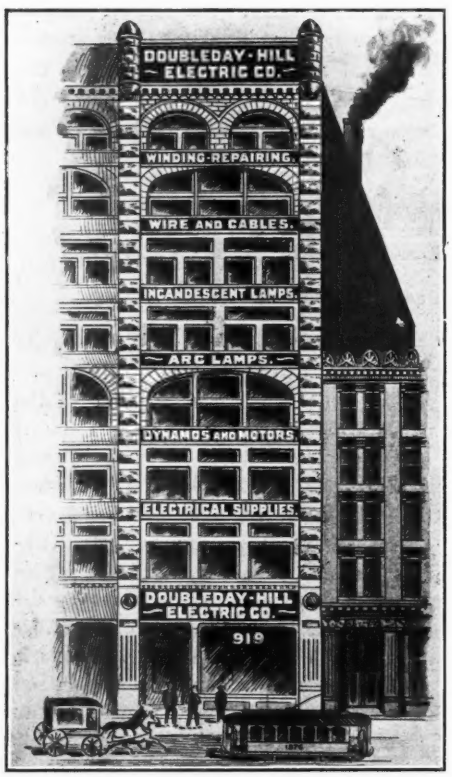
The "Michigan Technic."

The "Michigan Technic" is published annually by the Engineering Society of the University of Michigan. Volume xvi, for 1903, contains a number of articles of interest to electrical engineers. Professor G. S. Williams writes on "Some Phases of Hydraulics;" Professor G. W. Patterson, Jr., on "Illumination;" Dr. K. E. Guthe, on "The Electron Theory;" Mr. S. P. Grace, upon "Telephone Engineering;" Mr. C. T. Johnson, upon "Some Responsibilities of the Civil Engineer;" Mr. B. F. Bailey, upon "The High-Frequency Transformer;" and Mr. J. R. Bibbins, on "The Present Status of the Steam Turbine."

The Doubleday-Hill Electric Company.

The Doubleday-Hill Electric Company has recently moved into a new eight-story building at 919 Broad street, Pittsburg, Pa. A good view of this building is shown in the accompanying illustration.

Starting in a very small way at 609 Smithfield street six years ago, the company has enjoyed a remarkable growth. The original quarters having proved too small, the company removed to 525 Wood street three years ago, where it occupied a four-story building. Shortly after the first of the year the company removed to its present quarters. This is one of the



NEW HEADQUARTERS OF THE DOUBLEDAY-HILL ELECTRIC COMPANY.

largest buildings in the country devoted to electrical supplies and equipments.

The company carries a large line of supplies of every description, and special attention is given to the prompt despatching of every order. This company is the exclusive distributor for Triumph dynamos and motors, Adams-Bagnall arc lamps, Nernst lamps, Packard incandescent lamps, Emerson fans and many smaller specialties. A winding and repair department is operated by the company, in which it manufactures and repairs electrical apparatus of various kinds. An electrical pin and bracket factory is also operated at Ninevah, Pa.

Guy Anchors for Pole Line Construction.

The accompanying illustrations show the details of a novel form of anchor for

FIG. 1.—EARTH AUGER.

pole line construction, and an auger for boring the holes. Fig. 1 shows a com-

FIG. 2.—GUY ANCHOR.

bination auger which has an eight-foot stem, one inch in diameter. This auger

FIG. 3.—GUY ANCHOR.

is fitted with two boring heads, the smaller one for a special form of anchor, and the large head having adjustable blades. All augers have adjustable handles, and as the auger goes down the handle can be moved up to the stem.

To install this anchor a hole is bored from five to nine feet deep, at the same angle that the guy is to make to the pole. Figs. 2 and 3 give a good idea of the form of the anchor, and Fig. 4 shows the anchor sunk into the earth.

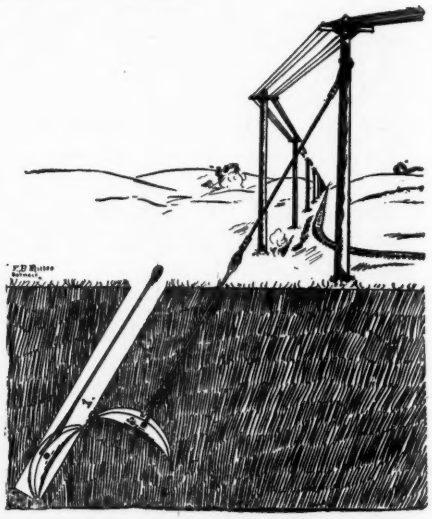


FIG. 4.—GUY ANCHOR IN EARTH.

After the holes have been bored the anchor is slid down to the bottom, and the dirt is then filled in and tamped in solid. After the earth has been tamped in solid the guy is drawn over a horse and pulled on to a standing pole at right angles to the strain. In this way the flange of the anchor is opened, taking a firm grip in the earth, and the danger of pulling the pole over under the strain is obviated.

The Kull System of Train Lighting.

A recent article by Paul Dupuy gives a somewhat detailed discussion of the Kull system of train lighting. Each car has mounted on it a small shunt dynamo driven from the axle and a set of small accumulators. The system is regulated by means of a speed governor, which alters the resistance in the field current of the dynamo as the speed of the car changes, and in this way maintains a fairly constant potential. This governor is mounted directly on the axle of the dynamo. In addition to this apparatus, there are automatic switches, one of which connects the dynamo to the battery and lamps, whenever the potential reaches normal, and the other introduces into the dynamo circuit a lamp resistance. The speed of the dynamo may vary from 650 revolutions per minute to 2,320, the latter figure corresponding with a train speed of 100 kilometres per hour. The voltage of this system is thirty-six. Each car is entirely independent, and can be connected to any type of train, local or express.—*Revue Practique de l'Electricite* (Paris), June 20.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

CHICAGO ELEVATED REORGANIZATION PLAN—It has been officially announced that the Lake Street Elevated Securities Company has received sufficient deposits of stock to warrant it in proceeding with its reorganization plan. This plan provides for an assessment on the stock, the retirement of the present five per cent bond issue with a four per cent issue, and the giving of stock in the new company for whatever assessment is made on the present stock issue of $1,000,000.

CLEVELAND RAILWAY MERGER RATIFIED—The stockholders of the Cleveland Electric Railway Company have unanimously approved the plan to absorb the Cleveland City Railway. The resolutions adopted in connection with this provide for an increase of capital from $13,000,000 to $23,400,000, the new stock to be given to the stockholders of the Cleveland City Railway in exchange for their stock. The directors of the new company were also elected, and the members chosen include all of the present members of the directorates of the combining companies. These are H. E. Andrews, C. F. Emery, G. A. Garretson, M. A. Hanna, R. A. Harmon, C. Morris, George G. Mulhern, C. A. Otis, Jr., C. L. Pack, James Parmelee, L. W. Prior, R. R. Rhodes, W. H. Sanders, J. J. Stanley and J. H. Wade.

LOUISVILLE INTERURBAN CONSOLIDATION—The consolidation of the traction and interurban companies of Louisville, Ky., has practically been completed. The company, which will have a capital stock of $14,500,000, has filed papers of incorporation in the Hudson County clerk's office, New Jersey. The incorporators are K. K. McLaren, Louis B. Dailey and Joseph M. Mitchell. The consolidated company will operate under the name of the Louisville Traction Company. The company is formed to purchase or otherwise acquire or construct, control or lease, maintain and operate by electricity or other power, steam, electric and street railways for the transportation of passengers, mail, express and merchandise; and pole lines, wires, viaducts and underground subways or conduits for the transmission or distribution of electricity or other mechanical power.

NEW CONNECTICUT POWER COMPANY—The Eastern Connecticut Electric Power Company, which was recently incorporated with corporate headquarters in Hartford, and which proposes to develop a large power plant in the eastern section of the state, has accepted its charter and perfected its organization. The company is authorized to issue capital stock up to a maximum amount of $900,000. It will develop water powers on the Quinnebaugh River, in the towns of Plainfield and Canterbury. The concern proposes to sell electric power to street railways, electric light companies and manufacturing establishments in Windham and New London counties. The franchise authorizes it to distribute electric power not only in eastern Connecticut, but in Massachusetts. The water privileges which the corporation proposes to develop are said to have a capacity to supply a minimum of 1,800 horse-power, and a maximum of 2,200 horse-power.

GROWTH OF ELECTRIC ROADS—The Census Bureau has issued a report on the street and electric railways of the United States, showing by statistical computations the increase of electricity as a motive power. The report shows that there are in existence in the United States 817 operating street and electric railway companies, and 170 companies leased to and operated by other companies, making a total of 987 companies, controlling 22,576.99 miles of single track. The par value of the capital stock and funded debt outstanding amounted to $2,308,282,099. The average net capital liabilities per mile of single track were $96,287. The increase in the length of track is confined entirely to the roads operated by electric power. The single-track mileage increased from 8,123.02 miles in 1890 to 22,576.99 miles in 1902, or 177.94 per cent, and the number of fare passengers carried from 2,023,010,202 to 4,809,554,438, or 137.74 per cent. The total reported cost of construction increased $1,778,276,788, or 456.7 per cent, since 1890. In New York there are in operation ninety-six companies, with gross earnings from operation in 1902 of $59,315,606, and operating expenses of $33,667,724, or 56.78 per cent of the earnings.

MISSOURI ELECTRIC INSTALLATIONS IN MERGER SCHEME—With the passing of the Missouri Edison Electric Company into the hands of the North American Company, of New York, and other interests which recently purchased it, a plan is reported for the consolidation of all the electric power companies with the street railways of St. Louis into one corporation with a capital of $141,000,000. For the reorganized Missouri Edison Company, William F. Nolker, a director in the Mississippi Valley Trust Company, was elected president, and Mr. August Gehner, also a director in that institution, was made vice-president. The new directors are Charles H. Huttig, H. C. Stifel, C. Marquard Foster, E. H. Benoist, Philip Stock, Henry S. Ames, William D. Orthwein, and Messrs. Gehner and Nolker. The reorganization is a temporary one, it being the intention of the new owners of the property to consolidate with the Union Electric Light and Power Company. The Union Electric Light and Power Company has in course of erection a $6,000,000 plant, located at the foot of Biddle street. This plant will have a capacity of 25,000 kilowatts, and the company has a contract with the World's Fair Company to furnish it with light and power during the exposition period.

ELECTRIC LIGHTING.

ST. LOUIS, MO.—The Interstate Transit Company, of East St. Louis, has secured a fifty-year franchise for an electric light and power plant on the East Side.

ST. LOUIS, MO.—The Taylorville gas and electric companies, of Taylorville, Ill., have been consolidated and sold to A. H. Bickmore & Company, of New York city. The consideration was $85,000.

SAN FRANCISCO, CAL.—The Independent Gas Company and the Independent Electric Company have been sold by Glaus Spreckles to the San Francisco Gas and Electric Light Company for $6,000,000.

OROVILLE, CAL.—It is stated that the Nimshew power plant, on Butte Creek, will be put in operation in about two months. This plant will generate about 20,000 horse-power. The same company owns a power-house at Centerville, about six miles below the Nimshew plant, where something like 8,000 horse-power is being generated.

NATCHEZ, MISS.—It is said that the Natchez Street Railway and Power Company is being reorganized under the name of the Vicksburg Light and Traction Company. Mr. S. S. Bullis, president of the Natchez company, has been elected president of the reorganized company. The sum of $129,000 has been set aside for possible changes.

BALTIMORE, MD.—Articles of consolidation and merger made between the Norfolk Industrial Company and the Montgomery Power Company have been filed in the clerk's office at Rockville. The two companies have been incorporated under the laws of Maryland, under the name of the Potomac Power Company. The capital stock is $110,000.

YAZOO CITY, MISS.—Final arrangements have been made whereby the municipality of Yazoo City becomes the owner of its own electric lights, waterworks and sewerage. The plant of the Yazoo Improvement Company has been purchased at a cost of $28,500, and the company has passed out of existence. The city will erect new buildings for the plants at a cost of $37,000.

CHICAGO, ILL.—The North Shore Electric Company has executed a mortgage for $350,000 to the Equitable Trust Company, maturing on October 1, 1912, and bearing five per cent interest. It is for the purpose of refunding its existing indebtedness and developing the road's business. It covers the property of the company in Highland Park, the electric lighting station in Waukegan, and all other property of the company.

ELECTRIC RAILWAYS.

ITHACA, N. Y.—The controlling interest in the Ithaca Street Railway property has been sold by E. G. Wyckoff to George F. Archer and others, of Camden, N. J. The consideration was over $500,000.

ROCKFORD, ILL.—The first survey of the Rockford-Madison electric line, which will pass through Green County, Wis., has been completed, and the right of way is being purchased. The actual measurement from Rockford to Madison by the new line is seventy and three-fifth miles.

EXETER, N. H.—The Epping, Brentwood & Kingston Street Railway Company, chartered at the last session of the legislature with an authorized capital of $200,000, has been organized with the following directors: Russell H. Fellows, of Brentwood; Levi W. Bartlett and L. Waldo Collins, of Kingston; D. Frank Fellows, of Brentwood; John Scammon, of Exeter; J. A. Edgerly, W. S. Goodridge and others.

CHARLESTON, W. VA.—The Kanawha County Court has granted a fifty-year franchise to the Kanawha Water and Light Company to build a line of electric road over the public highways in the county. It is the intention of the company to build and operate an interurban line up and down the Kanawha River for a distance of about fifty miles, connecting Charleston with the numerous mining towns along the Kanawha.

INDIANAPOLIS, IND.—The Indianapolis & Eastern Traction Company has completed its line between this city and Richmond, and work has begun on the road east of Richmond. It will be completed to Dayton by the fall, and it is stated that arrangements have been made for operating through cars between Cincinnati and Indianapolis on the completion of the Dayton-Richmond extension, cars running to Cincinnati over the Cincinnati, Hamilton & Dayton from Dayton.

SCHENECTADY, N. Y.—The Schenectady division of the Fonda, Johnstown & Gloversville Railroad was opened on June 30. A special car, with the officers of the company and their guests on board, left Schenectady about 9 A. M., reaching Amsterdam about ten o'clock. The distance is sixteen and one-half miles. The first survey for this road was made on July 1, 1901, and the work of construction was begun in October of the same year. The powerhouse of the company is located at Tribes Hill.

MILWAUKEE, WIS.—Articles of incorporation of the Withee & Maplehurst Electric Railway and Light Company have been filed at Madison by W. K. McElroy, F. C. Eschweiler and E. H. Naber. The new company, which will have a capital of $50,000, is formed for the purpose of constructing, purchasing or leasing street railways, power and lighting plants. Its main object will be the construction of an interurban line between Withee and Maplehurst, in the northern part of Clark County, to be used for passenger traffic only.

DUBUQUE, IOWA—Two more electric lines will be constructed from Dubuque west in the next year by the Dubuque & Western Railroad, it is stated. One of the roads will run through the northern part of the county, and the other through the southern part. Both will start at Dubuque, but the ultimate destinations have not been determined upon. The officers of the company are as follows: Peter Kiene, Dubuque, president; Jesse C. Bennett, New York, vice-president; Everett M. Mabie, New York, secretary; Charles H. Eighmey, Dubuque, treasurer.

LOUISVILLE, KY.—The incorporation papers of the Louisville & Cincinnati Interurban Railway Company, with a capital of $50,000, have been filed. The company, which is composed of Louisville, New Albany and Jeffersonville men, proposes to build a line direct from Jeffersonville to a point near Cincinnati now reached by the Cincinnati & Aurora Company, connecting there with this line for Cincinnati, and at Jeffersonville with the proposed interurban across the Big Four bridge, thus completing a line between Louisville and Cincinnati. The directors of the company are George B. Lewman, president of the First National Bank, of Louisville; John F. McCulloch, New Albany; John C. Zulauf, Jeffersonville, and Louis Hartman, of New Albany. It is estimated that it will cost about $3,000,000 to get the line in operation, and there is said to be ample capital back of the undertaking.

TELEPHONE AND TELEGRAPH.

HEVER, ARK.—A telephone line is to be erected between Guidon and Melbourne.

OTTUMWA, IOWA—The Iowa Telephone Company will erect a building in this city, to cost $20,000.

WAYNESBURG, PA.—The South Penn Telephone Company has been organized here with a capital of $200,000.

ROSEAU, MINN.—The village council has granted a franchise to C. A. Pearson to put in a local telephone system.

DES MOINES, IOWA—The Robinson & Wilson Telephone Company has been incorporated with a capital of $60,000.

DES MOINES, IOWA—The American Telephone and Telegraph Company will extend its line to Minneapolis *via* Cedar Rapids.

MINNEAPOLIS, MINN.—The capital stock of the Dell Rapids Telephone Company has been increased from $2,000 to $25,000.

NORWICH, CT.—The Gagon Selective Telephone Company has been organized with M. McGilliciddy and M. F. Brown as officers.

MACON, MISS.—The entire system of the Macon Telephone Company has been bought by T. J. Evans and J. W. and T. B. Haulett.

SALISBURY, MD.—The Diamond State Telephone Company has completed the reconstruction of its line between Salisbury, Berlin and Ocean City.

PADUCAH, KY.—Work is being pushed by the East Tennessee Telephone Company upon its long-distance line between Paducah and Paris, Tenn.

CINCINNATI, OHIO—A new branch telephone exchange, to cost $400,000, will shortly be built in this city by the City & Suburban Telegraph Association.

ATLANTIC CITY, N. J.—Improvements which are ultimately to cost close to $100,000 are about to be begun to the system and plant of the Atlantic Coast Telephone Company.

EL RENO, OKLA.—The Consolidated Telephone Company has completed the purchase of the Western Oklahoma Telephone Company's property, the purchase price being $20,000.

INDIANAPOLIS, IND.—The Posey Home Telephone Company has been incorporated with a capital of $30,000, by Allen Gray, Evansville; W. M. Ford, New Harmony, and Braddock McGregor, Mt. Vernon.

CRESTON, IOWA—The stockholders of the Creston Mutual Telephone Company have voted to increase the capital stock of the company from $80,000 to $100,000, and to expend $12,000 in improvements.

PITTSBURG, PA.—The capital stock of the Pittsburg & Allegheny Telephone Company will be increased from $1,500,000 to $5,000,000, and a change in the controlling interests of the corporation will ensue.

BINGHAMTON, N. Y.—A new telephone company has been organized in Windsor, called the Lester Telephone Company. The officers are H. A. Williams, A. Judd and A. Andrews. The line will run from Lester to Windsor.

NEW YORK, N. Y.—The Northeastern Telephone and Telegraph Company, of Newark, has been incorporated by Union N. Bethell, William T. Bouchelle, Walter Brown, John H. Cahill and Howard Thurber. The capital of the company is $100,000.

BIRMINGHAM, ALA.—The Western Union Telegraph Company announces that it has begun the construction of a line along the route to be covered by the Mendenhall and Columbia branch of the Gulf & Ship Island Railroad, now in course of construction. The line will be sixty miles long.

JERSEY CITY, N. J.—The East Jersey Telephone and Telegraph Company has filed a certificate of agreement to the consolidation with the North Jersey Telephone and Telegraph Company and the Northeastern Telephone and Telegraph Company. The capital of the consolidated corporation is $100,000, and the directors are U. N. Bethell, W. T. Bouchelle, W. Brown, J. H. Cahill and H. F. Thurber.

ELECTRICAL SECURITIES.

The persistent raids which the bear interests have made on the stock market for the past ten months have resulted in a condition of affairs which has seldom been approached. It is natural that a pessimistic view of the immediate speculative outlook should be taken, in the face of genuine efforts of a number of financiers to raise the level of prices. Notwithstanding the fact that there has been a number of large dividends paid, and the closing of the half-yearly business will show a balance account in almost every industry which is entirely favorable, the reinvestment and new investment outlook is said to be decidedly adverse. This condition is no doubt by reason of the apparently strong hold which the bear interests have, and the possibility of forcing values still lower.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JULY 11.

New York:	*Closing.*
Brooklyn Rapid Transit	54⅝
Consolidated Gas	188½
General Electric	173
Kings County Electric	200
Manhattan Elevated	134½
Metropolitan Street Railway	119⅛
New York & New Jersey Telephone	155
Westinghouse Manufacturing Company	190

Boston:	*Closing.*
American Telephone and Telegraph	129¼
Edison Electric Illuminating	245
Massachusetts Electric	90
New England Telephone	130
Western Telephone & Telegraph preferred	90

An additional $5,018,700 of the capital stock of the American Telephone and Telegraph Company has been listed on the New York Stock Exchange, making the total amount listed to date $109,700,100.

The Board of Gas and Electric Light Commissioners has approved of the issue by the Edison Illuminating Company of 20,000 shares of additional capital stock at the par value of $100 each. the proceeds to be applied to the following purposes: The proceeds of 10,000 shares to the payment of obligations now existing or which may hereafter be incurred; the proceeds of 10,000 shares to the purchase of the electric lighting plants located in Milton, Dedham, Canton, Natick, Framingham, Woburn, Somersville, Chelsea, Newton and Needham.

Philadelphia:	*Closing.*
Electric Company of America	8¾
Electric Storage Battery common	60
Electric Storage Battery preferred	60
Philadelphia Electric	6
Union Traction	44⅞
United Gas Improvement	86¼

At a meeting of the board of directors of the Electric Company of America, the president reported that the full returns for five months show that in the net earnings there was a gain of more than 19 per cent over the same period of the previous year. The board passed a resolution unanimously advising that the par value of the stock be increased from $10 to $50 a share. A special meeting to vote on this question will be held in the fall.

Chicago:	*Closing.*
Chicago Telephone	115
Chicago Edison Light	146
Metropolitan Elevated preferred	66
National Carbon common	23
National Carbon preferred	93
Union Traction common	3½
Union Traction preferred	30

LEGAL NOTE.

A SPECIAL CASE OF THE RIGHT OF EMINENT DOMAIN—The flooding of land by a dam for manufacturing purposes is held in Avery *vs.* the Vermont Electric Company (Vermont) 59 L. R. A. 817, to be a taking within the meaning of the constitutional provision regulating the taking of land by right of eminent domain. An extensive note to this case collates all the other authorities on liability for damming back the water of the stream.

PERSONAL MENTION.

DR. SAMUEL SHELDON, professor of physics and electrical engineering at the Polytechnic Institute, Brooklyn, N. Y., is summering at Middlebury, Vt.

MR. H. DURANT CHEEVER, of the Okonite Company, Limited, returned on the Cedric this week after a ten weeks' sojourn in European capitals. Mrs. Cheever accompanied him, and both returned with best of health.

MR. VINTON H. SEARS, president and manager of the New England Automatic Telephone Company, and Miss Francis L. Olive, daughter of Mr. and Mrs. George W. Olive, of North Cambridge, Mass., were married on June 30 at the home of the bride's parents.

MR. EDWARD B. ELLICOTT, the well-known city electrician of Chicago, has been awarded the Octave Chanute medal for the best paper on an electrical engineering subject read before the Western Society of Engineers during the year 1902. This paper was entitled "The Transmission of Fire Alarms."

MR. R. S. KELSCH, of Montreal, formerly of Chicago, has resigned as general superintendent and engineer of the Lachine Rapids Hydraulic and Land Company, and has opened an office as consulting engineer in Montreal, at 44 Street Railway Chambers. Mr. Kelsch has been appointed consulting engineer of the Montreal Light, Heat and Power Company, and is building a lighting plant in Nova Scotia.

MR. EDWARD R. KNOWLES, New York city, has been retained as consulting engineer for the heat, light and power installation to be made in the Publishers and Printers' Building, to be erected at West Thirty-seventh and West Thirty-eighth streets, New York city. This installation will be one of the largest of its kind in New York city, and the enterprise will be well handled, as Mr. Knowles brings to this work a large experience in matters of this kind.

STATE ELECTRICAL CONTRACTORS.

The two state associations of electrical contractors of New York and Pennsylvania held separate meetings at Buffalo on Tuesday of this week. The Pennsylvania association met at nine o'clock in the Iroquois Hotel. The New York association met at ten o'clock in the Board of Trade Building. Owing to the illness of President S. Davis, of the New York association, the vice-president, Marshall Barnes, presided. The meeting of the New York association was devoted to routine business as no change in officers was in order and matters of vital interest were held for discussion at the meeting of the National Association at Detroit the following days.

President Mathieu presided over the Pennsylvania meeting, and after discussing the several phases of the labor question, etc., adjourned.

The impression obtaining as the result of these two state meetings is that the serious labor questions of the last months are likely to reach an early settlement, and it is the feeling that the National Association will accomplish much good in this direction.

Among those on the special cars *via* the New York Central system and those who had gone earlier to Buffalo were James Dole, president Dole Manufacturing Company, New York; James F. Burns, Schenectady; Major Robert Edwards, Western Electric Company; E. S. Keefer, Western Electric Company; C. E. Corregan, Osburn Flexible Conduit Company; A. S. De Veau, De Veau Telephone Manufacturing Company; F. S. Blackhall, of Blackhall & Baldwin; George S. Searing, Hart & Hegeman Manufacturing Company; Charles L. Eidlitz, president the National Electrical Contractors' Association; H. B. Kirkland, R. B. Corey and Thomas Bibber, of the American Circular Loom Company, and the following from the Philadelphia association were on the New York train: Frederick W. Myers, Edwin R. Keller, Walter McIntyre, T. Carpenter Smith, Gilbert S. Smith, H. A. Loeb. G. W. Swan and Frank Harrington, of John A. Roebling's Sons Company, Trenton, N. J., and George F. Porter, Atlantic Insulated Wire and Cable Company, of New York, and W. H. Browne, of the Stanley Instrument Company, of Great Barrington, Mass., were also in the party. Both the New York state and Pennsylvania state delegates and visitors left by steamer Tuesday evening for the meeting of the National Association at Detroit.

INDUSTRIAL ITEMS.

THE H. O. S. ENGINEERING COMPANY announces a change of address from 277 Broadway to 88 Warren street, New York city. The new office will be connected with a large stockroom where the company will carry a complete stock of knife switches and panelboards for prompt deliveries.

THE B. F. GOODRICH COMPANY, Akron, Ohio, is the well-known manufacturer of a strong line of tires for automobiles and other vehicles. This company has recently published a magnificent art souvenir entitled "Ruth," showing in colors a life-sized drawing of a beautiful woman.

THE MUSSO DUPLEX TYPEWRITING WIRELESS TELEGRAPH COMPANY, Wallace Building, New York city, has been incorporated under the laws of the state of Maine. The officers are Guiseppe Musso, president; James M. McCormack, vice-president, and Robert E. Sylvester, secretary and treasurer.

MESSRS. WICKES BROTHERS, Saginaw, Mich., machinery manufacturers, issue regularly a monthly stock list of new and second-hand boilers, engines and machinery. The list is carefully classified, and the company states that a number of good bargains can always be obtained by looking up this list.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., is meeting with great success in introducing the new "Zenith" Packard lamp. This lamp is made in two sizes, twenty-five and fifty-five candle-power, the latter in two efficiencies, 1.9 and 2.18. The lamp is ornamental, and produces a fine quality of light.

THE MARSHALL-SANDERS COMPANY, Boston, Mass., reports a very large increase in the use of its well-known line of sockets. The company credits this increase entirely to the effect of automatic methods. This company has perfected a complete line of automatic machines for producing a high grade of sockets.

THE A. L. DYKE AUTOMOBILE SUPPLY COMPANY, 1402 Pine street, St. Louis, has removed to 2108 Olive street. This gives the company larger quarters on one of the most prominent streets in St. Louis. The change of address has been found necessary owing to the increasing and rapidly growing business.

MR. C. HUDSON MACHEN, sales engineer representing the Cutter Company, of Philadelphia, announces that he is prepared to submit blue-prints and give any information required relative to "I. T. E." circuit-breakers and Keystone measuring instruments. Mr. Machen's office is at 120 Liberty street, New York city.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., announces the change in address of its New York Exide depot, which was formerly located at 148 West Eighteenth street. This depot will hereafter be operated by the New York Transportation Company, at Forty-ninth street and Eighth avenue.

THE SUMTER TELEPHONE MANUFACTURING COMPANY, Sumter, S. C., is now building a large addition to its works, which will more than double the present capacity. This addition will give about 20,000 feet more space, and will be ready for occupancy in about sixty days. The great increase in business has necessitated the additional working room.

THE BUFFALO & DETROIT STEAMBOAT COMPANY announces the opening of the new lake route between Detroit and Buffalo. The new steamers, Eastern States and Western States, are running daily between the two points, making connection with all morning trains. Mr. A. A. Schantz, G. P. T. manager, Detroit, Mich., will be pleased to send descriptive literature on request.

THE BENBOW COMPANY, 215 Rothschild Building, Philadelphia, is placing on the market the Benbow adjustable swinging telephone bracket. This is a convenient and up-to-date device. The company states that this apparatus will be sent on trial, and the claim is made that it will give positive satisfaction. The telephone brackets are made of oxidized copper, nickel-plated.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Chicago, Ill., and Rochester, N. Y., has recently closed contracts for switchboards for the following companies: Adena Telephone Company, Adena, Ohio; Vigilant Telephone Company, Dillonville, Ohio; Morrow County Telephone Company, Mount Gilead, Ohio, and also a large number of telephones to the last-named company.

THE COLUMBUS STEEL ROLLING SHUTTER COMPANY, Columbus, Ohio, has appointed the Pittsburg Cornice and Skylight Company, Pittsburg, Pa., as its exclusive agent for eastern Ohio, western Pennsylvania and West Virginia. This agent has already sent in orders for steel rolling shutters for the new Joseph Horne Building and the Bailey-Farrell Manufacturing Company's building, both in Pittsburg.

THE GARVIN MACHINE COMPANY, New York city, announces that its stock of machine tools was never as complete as at the present time, and that the showrooms were never in better shape to afford a very complete inspection of a fine line of machinery. Recent consignments from two large eastern concerns have put the second-hand tool department in fine shape for inspection, and the company will be pleased to send its descriptive lists to any one needing quick shipments of first-class machine tools.

THE NERNST LAMP COMPANY, Pittsburg, Pa., announces a recent test of the Nernst lamp, which was made at the instance of F. O. O'Neill, jeweler, of Kingston avenue, Philadelphia. This showed an average consumption per hour of eighty-eight watts, which is stated to be about half which was required for incandescent lamps giving the same amount of light. The Nernst lamp possesses desirable features in the illumination of jewelry or other stores requiring a brilliant light showing true color values. Twenty Nernst lamps have been installed in this store.

THE CONSOLIDATED RAILWAY, ELECTRIC LIGHTING AND EQUIPMENT COMPANY, 100 Broadway, New York city, states that Consolidated "Axle Light" equipments for electric car lighting are steadily coming into general use on the best and fastest trains of leading railway lines, including the Pullman cars on all of the trains. With the private Pullman cars and business cars of railway officials, the "Axle Light" equipments are very popular. These equipments are beginning to be used quite extensively on railway systems of Great Britain and Europe.

THE H. W. JOHNS-MANVILLE COMPANY, 100 William street, New York city, is in receipt of a testimonial letter from Mr. Barney E. Oldfield, of Toledo, Ohio, who recently made a distance of five miles in five minutes, four and three-fifths seconds, in his racing automobile, as follows: "In breaking the world's automobile record for one mile and five miles to-day (Indianapolis, Ind., June 20, 1903), my racing machine was packed with the Johns-Manville Company's 'Molilene' packing. This packing successfully withstood the tremendous strain incident to this service, and I hereby recommend it to whom it may concern."

THE EUREKA ELECTRIC COMPANY, Genoa and Chicago, Ill., has recently supplied the Hoosier Telephone Company, of Salem, Ind., with a 300-line switchboard of its new Bell style ring-down type. This company is making a specialty of this style of board, and anticipates a large sale of them, since it is remarkably simple in construction and operation, and combines many desirable features. The company has completed its new factory at Genoa, Ill., which gives it three times its former capacity; and it claims that, from the present outlook, it will be necessary to enlarge the factory before a year elapses.

THE NEW YORK LIFE INSURANCE COMPANY, in its fifty-eighth annual report, makes a detailed statement of the condition of its affairs financially. The report shows the total assets of the company to be $322,840,900. The total cash income for the year was $79,108,401.34, and the total disbursements, $46,925,591.47. Since January 3, 1902, the company has filed its fifty-seventh annual report with the insurance departments of eighty-two separate and distinct governments throughout the civilized world. The total market value of all the bonds held by this company is $225,039,295. The gross income from properties is $906,707.41, and the total outgo on the properties is $430,023.81, leaving a net income of $476,683.60. The total value of mortgaged property is $49,417,965.